THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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PORTSMOUTH MUNICIPAL TELEPHONE ACCOUNTS.

THE Portsmouth Corporation have recently circulated the accounts of the municipal telephone department for the year ending March 31st, 1906, and there is much jubilation in the Socialistic Press over the alleged "profit" of £1,849 shown for the year's working.

These accounts are a remarkably good specimen of the special pleading indulged in by town councillors in the endeavour to justify the municipal trading mania, and they illustrate once again the calm disregard of common-sense business methods displayed in the financial management of technical businesses under municipal control. It has become abundantly evident that the municipalities which engaged in the working of telephone systems have underestimated the cost of conducting the business, have fixed rates far too low to be remunerative, and have wasted large sums of money in adopting, for the sake of cheapness in first cost, obsolete plant which shrinks 50 per cent. in value the moment it is put in use. For nearly a year past the five telephone municipalities have been engaged in a frantic struggle to sell out their telephone concerns to the Postmaster-General, and in those cases where the Postmaster-General has been willing to make an offer, that offer has been about two-thirds of the book cost of the plant.

This fact alone should suffice to convince responsible people that there is something fundamentally wrong with municipal telephony. If the municipal telephone concerns were run on their merits as a business, the fact that an expert valuation shows that the capital account has shrunk by at least one-third in value in three or four years of active operations should awaken the municipal telephone committees to a sense of their responsibility, and to the necessity for readjusting the financial management of their enterprises. But to admit even the possibility of error is quite foreign to the principles and practice of municipal trading. The business is shown by competent authorities to be radically unsound; then all the more reason for claiming a large profit. It is shown by the valuation of leading experts that depreciation should have been charged at the rate of about 10 per cent. annually; Portsmouth blandly ignores the experts and ignores depreciation. Portsmouth goes further still, it pays sinking fund and interest on only a portion of the capital, instead of on the whole, and treats such an item as engineer's commission, amounting to £1,860, not as a preliminary expense to be wiped off, but as an asset, subject to no depreciation whatever!

The manner in which the "profit" is arrived at is highly interesting. Four general methods are clearly disclosed by a brief examination of the accounts. (1) Depreciation is not charged at all; in the original estimate depreciation was provided for at the rate of 2½ per cent., and the Postmaster-General's valuation shows that that rate is much too low; to

charge depreciation as originally provided for would make a serious hole in the "profits," as by this time the total depreciation fund, at 2½ per cent., would amount to over £2,200; to charge depreciation at the rate suggested by the Post Office valuation would wipe out the "profits" and leave a large deficit; so the accounts are silent regarding depreciation. (2) Revenue charges are unduly low and capital charges unduly high. The amount charged to line, instrument, and exchange repairs for the year, *i.e.*, for the maintenance of the system, was £1,599, which for a system containing 10 exchanges, 2,146 miles of overhead wire, 3,500 miles of underground wire, and 2,475 telephones, is an extremely economical figure. On the other hand, no less than £5,292 was added to capital account during the year, though little new work was done, and it is curious to find that instruments averaged only £2 19s. each up to the beginning of the year, but this year cost £5 6s. each, while underground work had previously cost only £8 10s. per mile of metallic circuit, and in 1905-6 cost no less than £13 19s. per mile of metallic circuit. In referring to the Swansea telephone accounts the other day, we pointed out how oddly the extremely low charges for maintenance compared with the relatively large capital expenditure for the year. It would seem that this characteristic feature of municipal telephone accounts has its effect in producing the annual "profits," which must not be absent from those accounts. (3) Sinking fund and interest are paid on but a portion of the capital; there is an overdraft on the city treasurer of no less than £6,930, and on this sum sinking fund and interest are not paid, while even allowing for this large amount being provided free of interest and sinking fund, the amounts charged against those items still do not respectively work out at 3 per cent. on the actual loan capital. The total at present standing to the credit of sinking fund is £2,538, or just under 5·7 per cent. on the total capital of £44,532, after four years' working. This comparison throws an interesting side-light on the effectiveness of a sinking fund as a substitute for depreciation. (4) All rentals are treated in the accounts as if paid in full, although the balance-sheet shows that no less than £4,494, or over two-fifths of the total annual revenue, is overdue from subscribers. The only offset against this is an allowance of £300 for bad debts. As telephone rentals are payable in advance (and if they are not paid the telephone concern has the simple and effective remedy of cutting off the service) the natural deduction from this remarkable item, which is an annual one and grows annually, is that the Portsmouth Telephone Committee are supplying free telephones to a number of people, but taking credit for them in the accounts as if they were paid for in full.

If due allowance be made for all these various drawbacks, it will be seen that the Portsmouth municipal telephone department, instead of being in the flourishing state which the alleged "profit" is designed to show, is really conducted at a large annual loss. The loss on capital account already amounts to over £10,000, as shown by the Post Office valuation. The actual loss will be much larger than this, as the cost of bringing the system up to date would be more than twice £10,000. The Swansea municipal telephone manager stated the other day that to convert the Swansea municipal system to the Post Office standard of telephone working would cost from £15,000 to £20,000. The Portsmouth system is larger than that of Swansea, so that the cost of conversion to modern apparatus and methods would be greater at Portsmouth than at Swansea. Doubtless the Postmaster-General expects to bear part of the great cost of bringing the municipal telephone systems up to date out of the funds of his own department, though why he should do so is a mystery. All of the expenditure required to reconstruct the municipal telephone systems might have been saved had not the municipalities been obsessed by the idea that the sole feature to be considered in telephone work was extreme cheapness.

What the loss on the annual working of the Portsmouth system amounts to, depends on several factors—depreciation, distribution of expenditure to capital and revenue, and the actual *bonâ fide* revenue. It is impossible to say what the latter figure actually is, as only a serious attempt to collect the outstanding accounts would determine how much of the two-fifths overdue rentals would materialise in cash. However, if depreciation and maintenance costs were properly charged, and interest and sinking fund paid on the full capital, the present annual loss would probably work out at between £4,000 and £5,000.

THE COMPARATIVE VALUE OF COMPARISONS.

It is a pity that Mr. W. A. Vignoles's paper on "The Efficiency of Steam Plant," read before the Municipal Electrical Association, should have contained a fallacious comparison in its second paragraph.

In it we find comparisons of coal and steam consumptions on H.M.S. *Commonwealth*, an 18,500-H.P. battleship, at about two-thirds full power, and on H.M.S. *Diamond*, third-class cruiser, with 10,000 H.P. under forced draught, with the performance of an engine in that mammoth undertaking, the Grimsby Corporation Electricity works, during a peak load of 211 KW. In place of taking indicator cards on his engines and comparing the steam consumption per I.H.P. in each case, Mr. Vignoles considers the marine engines as driving dynamos, the overall efficiency being taken as 85 per cent., and the coal is reckoned per assumed KW.-hour. The conclusion is then announced that the equivalent water per KW.-hour on H.M.S. *Commonwealth* works out at 26·6, on H.M.S. *Diamond* at 34·1, and at Grimsby at 46·6. The author guilelessly acknowledges that "conditions in an electricity works are entirely different to those on shipboard . . . ." The cream of the joke appears in the next few words: "*and it is doubtful if any electricity works can compete in steam consumption with the best results obtained in ships*" (the italics are our own). Perhaps not, if conditions prevailing throughout a day when the station load factor is 15 or 20, and that of the battleship 60 to 100 per cent., are contrasted. But even for full load conditions the author's explanation is anything but comprehensive. "In this connection the author thinks that one of the great disadvantages on board ship, want of space, is a blessing in disguise. Space is so valuable that the boilers are placed close to the engines, the length of steam pipes is reduced to a minimum, and everything possible is done to avoid complications which would take up room; in this way a great many losses are avoided." So, with this explanation, these ponderous figures, which serve as a foreword to the paper itself, are dismissed. Not a word about the difference in size of the installations, not a word about differences in steam pressure, superheat, or vacuum, or in the types of engines employed. In the case of H.M.S.

Commonwealth we have a first-class battleship with twin screws, and engines capable of giving 9,000 H.P. under forced draught. In the case of H.M.S. *Diamond* we have engines driving twin screws, the horse-power of each engine being 3,500 under normal draught, and 4,900 under forced draught conditions. In the mammoth electricity supply undertaking at Grimsby we have eight Belliss & Morcom high-speed direct-coupled sets, and the performances of a set working at a load of about 320 H.P. The next thing that we shall have in serious comparisons will be that of the relative accelerations, say, of a New Forest Lizard and the Diplodocus Carnegii at South Kensington!

But Mr. Vignoles may take heart. There is no need to abase himself because his consumptions per kilowatt-hour are high compared with those per assumed equivalent kilowatt-hour of certain naval vessels. If he is not yet aware that the consumption per unit output at full load decreases with the size of the engine under consideration, some brother electrical engineer or some steam engine builder will complete his education on this point. Or, alternatively, if he studies only two chapters from a book recently sent to us for review, he will find an instructive curve which gives the mean steam consumptions for the reciprocating engines of four typical firms. Given 50° C. superheat, a 26-in. vacuum and 185 lb. pressure per sq. in., a 200-KW. engine should consume about 22 lb. of steam per KW.-hour, while a 2,000-KW. engine should consume about 17 lb.

A better comparison can be made with an ideal engine working on the Rankine cycle, when the actual consumption in thermal units per I.H.P. per minute is compared with the theoretical consumption of an ideal engine with no clearance, or radiation, or friction losses. First, let those who discover superior economies in Admiralty vessels work out the thermal efficiencies of their own sets in a scientific manner. Next, let them, if they can (for the information is hard to get), work out similar efficiencies for steamship engines. Then it will be possible to compare the relative efficiencies of engines unlike in size, type, duty and conditions of working. But, even then, what practical value will such figures possess?

Electrical Superannuation.

We have from time to time referred in these pages to the British Electrical Superannuation Fund, but for two reasons we may now revert to it once more; first, a special effort is being made to extend its sphere of operations; and, secondly, there are many firms and companies who had not yet given such consideration as it deserves, to the desirability of benefiting their employés (and therefore their own businesses) by attaching themselves to this or any other pension fund organisation. There are many undertakings in connection with the electrical industry—lighting, tramway, power and manufacturing concerns—which may not be large or strong enough to form Pension Funds of their own, and most people are inclined to be amused when the political cry of State Old-Age Pensions is trotted out. Employés must, therefore, turn to some such fund as this, or take up an annuity or insurance policy with repayment at a specified age.

If a share in this Fund be compared with deferred annuities—with which it is really comparable—the advantages lie in important respects with the B.E.S.F. Such contingencies as death or enforced retirement before arrival at pension age, changing from one employment to another in connection with the electrical profession or industry, have all been specially regarded, and the applicant will find that special provisions have been made for his interests in these and many other respects which we need not stay to detail. It may be worth mentioning, as indicating the wide scope of the Fund, that a firm having as few as two employés can be enrolled.

The objects, advantages and form of management of this Fund are succinctly explained in pamphlets which have been placed in circulation. The Fund has been nearly six years in existence; it has a carefully-drawn set of rules, which have been settled by the solicitor to the Fund and a leading actuary; it has well invested funds amounting to nearly £16,000, and has had the advantage of a recent actuarial valuation. The trustees believe that the Fund constitutes a sound nucleus capable of considerable expansion within the electrical and allied industries.

We learn that it has been arranged to hold a Conference of companies interested in the matter early in July, when the scheme will be explained in detail.

Employers and others who are, or ought to be, interested in the matter, can obtain full particulars on application to the Secretary of the Fund, Donington House, Norfolk Street, W.C. We may add that a report of the annual meeting was published in our issue of March 30th, and would suggest that the matter is at least worthy of the closest investigation. It is common knowledge that railway companies, cable companies, banks and other large concerns have found it desirable to adopt superannuation schemes. Why should not our electrical undertakings do so, too? Inquiry shows that uncertainty of tenure of concessions is not an insurmountable difficulty.

Our Foreign Guests.

This week we are proud to have amongst us nearly 200 representatives of the electrical engineering industries of France, Germany, Italy, Switzerland, the United States and Canada. Politically, these great nations are separate and distinct from one another; it is, however, the boast of Science that to her all peoples and nationalities are one and indivisible, and Electrical Engineering, one of her most noble and flourishing offsprings, rejoices to echo that admirable sentiment. It is, then, as brothers that we greet our visitors, and extend to them a hearty welcome, trusting that their sojourn with us will be marked by every pleasant and enjoyable feature that is possible, and marred neither by our wayward weather, nor by any adverse influence whatever. We do not say "a hearty British welcome," for the simple reason that experience has taught us that the welcome accorded to ourselves abroad was in every case as hearty as our own could be; we would rather say "a hearty Electric welcome," for there seems to be no welcome which can exceed in cordiality the mutual greetings of electrical engineers. We hope that our guests will find something to admire, many things to please them, and not a few things to edify them, within our borders, and, as the acme of our hopes, that they will carry away with them memories no less delightful than those which we shall ever retain of our visits to their respective fatherlands.

Our Tramway Tables.

With this issue our tables of electric tramways, electric railways, and electric power companies of the United Kingdom are placed in the hands of our readers. The corresponding table of electricity works was published with our issue of June 8th; we have little to add to our introductory paragraph on that occasion, save to repeat the hope that the tables will be found useful, and accurate in the main, and once more to express our grateful indebtedness to the engineers and managers who, in spite of the pressure of their numerous duties, have found time to provide us with the data therein embodied.

D

ROYAL SOCIETY CONVERSAZIONE.

At the second Royal Society Conversazione on June 20th, there were very few exhibits of any electrical interest.

Mr. A. A. C. Swinton showed experiments in which visible luminous electrical discharges *in vacuo* were obtained with comparatively low electrical pressures. Edison, Fleming and others have shown that the passage of the electric discharge *in vacuo* is much facilitated by heating the cathode. Owen and Wehnelt have proved that this effect is enormously increased if the heated cathode be coated with oxides of alkaline metals. Mr. Swinton's experiments show that similar results can be obtained by coating the cathode with radium, and that the effect will be greater when the cathode is heated than obtains without heating.

Sir James Dewar exhibited a new charcoal calorimeter and thermoscope. Charcoal at the temperature of liquid hydrogen that has absorbed at atmospheric pressure considerable quantities of helium or hydrogen—or alternatively of nitrogen, oxygen, or air, at their respective boiling points—is utilised in this instrument as a material that, by reason of changes in the volume of the occluded gas, exhibits great sensibility to heat and light radiation, and can be used in calorimetry at the temperature of solid hydrogen.

Electric discharge tubes showed gradual gas absorption by charcoal cooled in liquid air until, after the Röntgen radiation stage, the electric resistance became so great that a discharge would not pass.

The new methods of investigating the stresses in masonry dams, devised by Prof. Karl Pearson and Mr. A. F. C. Pollard, are of considerable interest to engineers. They recommend as the result of their investigations that the shear distribution should be found in each case from a model dam, before the stresses are determined by graphical methods. The existence of stretch in the tail of dams of ordinary type is confirmed by experiments.

Those who are interested in colour photography would have been specially interested in the photographic prints in natural colours obtained by the Smith-Merckens process, and exhibited by Mr. Oliver S. Dawson. The specimens of prints shown had been made in an ordinary printing frame, by one exposure to light. When taken out of the frame, they possess the colours they exhibit. Ordinary "printing-out" paper is only capable of recording black and white, and the intermediate shades of grey. The new printing-out paper records every colour and shade. It necessitates using in the printing frame a coloured positive instead of the ordinary negative. The cost of colouring a positive from the ordinary negative is small.

Dr. G. T. Moody exhibited specimens illustrating the indifference of oxygen towards iron in presence of water, and the effect of the admission of carbonic acid. A specimen of Swedish iron remained perfectly bright after exposure for three weeks to water and 32 litres of air freed from carbonic acid. At the end of the period named, air cleaned by its passage through a tower packed with moist pumice-stone, but containing its normal amount of carbonic acid, was admitted. After 72 hours, during which time approximately 16 litres of air passed through, considerable rusting had occurred.

Mr. R. G. Durrant exhibited tubes, diagrams, and experiments to show that ionic separation occurs when solutions of acids or of salts are allowed to diffuse into sensitised jellies or solutions. Acids when they diffuse into blue litmus jellies produce a purple zone in advance of the diffusion front, and (where the acid has a bleaching union) a yellow-red zone behind the diffusion front. An acid mixed with litmus on diffusing, leaves the litmus behind. When concentrated silver nitrate solution diffuses into purple litmus under suitable circumstances, red, blue, colourless and grey zones—corresponding to H, OH, NO, and Ag, appear in this order. At certain periods sharp bands may form whose boundaries if measured from the diffusion start, almost exactly correspond to known mobilities of these ions.

Dr. F. D. Chattaway exhibited copper mirrors obtained by the deposition of metallic copper on glass. The method of silvering glass by depositing the metal in a thin film by reduction of some soluble silver compound has long been employed in the production of mirrors, but, hitherto, no method of similarly depositing copper in a brilliant film has been discovered. The exhibit showed a number of glass vessels on which copper had been deposited by a low reduction of the black oxide.

DIRECT-CURRENT TRANSMISSION IN COMPETITION WITH THE THREE-PHASE ALTERNATING-CURRENT SYSTEM FOR MILAN.

At a time when the direct-current system of Mons. Thury is in general consideration for the Zambesi Falls 700-miles transmission, and for various other important schemes, an examination of the report prepared by Signor Ing. Motta, of the Milan University, at the request of the City Council on the relative merits of the two schemes for the supply of power to the Milan Municipality, is of great interest.

The City of Milan now has its public lighting provided by its own steam plant, and the private lighting and power for traction is supplied by the Milan Edison Co. The tramway system, however, being the property of the Town Council, there is an agitation in favour of making the tramway system entirely municipal, and an exhaustive investigation has been undertaken by Signor Ing. Motta. The general conditions are as follows :—A water-power plant which is to be situated on the Upper Adda River in Valtellina, will have sufficient capacity to provide 38,200 B.H.P. at the turbines, or approximately 28,000 KW. at the secondaries of the transformers in Milan. The transmission line is to be 150 kilometres long, and passes over the Orobie Mountains, which are part of the Pre-Alpine Range, the highest point being 5,400 ft. above sea level.

The comparison is made on the basis of 150,000 volts continuous current, and 60,000 volts alternating three-phase current, these values being settled by consideration of the most economical voltage for each system.

The Thury system is to consist of 10 groups, each group having four generators driven by one water turbine ; the voltage per group is not to exceed a limiting value of 15,000 volts.

The transmission line is to have both positive and negative conductors, the earth not being employed as return. The centre point of the system is to be grounded. The 60,000-volt three-phase scheme will consist of units operating in parallel in the usual way, with no novel features, the exact frequency to be determined later, but probably 42 cycles.

The costs of the two schemes work out in round numbers as follows, the estimates being based on machinery, switchboards, line, insulators, poles, transformers for the A.C. system and motor-generator transformers at the receiving end of the D.C. system. The cost thus calculated shows in favour of the D.C. system by 1·6 per cent., the figures being approximately 10,009,000 fr. total for direct current and 10,160,000 fr. for the A.C. system.

A further comparison of interest is the division of the line and machinery costs into separate items, as follows :—

	Direct current.	Alternating current.
1. Machinery, including transformers, switchboards, &c.	7,000,000 fr.	3,750,000 fr.
2. Line, including insulators, poles, lightning arresters, &c.	3,000,000 fr.	6,410,000 fr.

The reason for this great difference in cost is stated to be partly the extra cost of the D.C. generators, but mostly the cost of the motor-generator step-down transforming units at the Milan end of the line ; whereas in the A.C. system only stationary transformers have to be purchased, which are comparatively cheap. The actual calculated cost of the machinery in the Milan (Thury system) sub-station is 3,600,000 fr.

The following information on the calculated efficiency of the different systems is of considerable interest :—

Direct-Current System.—The over-all efficiency of the two systems shows in favour of the three-phase scheme by 3 per cent., the efficiency throughout being based on the full load of 28,000 KW.

The detailed efficiencies are as follows :—

Water pipes	96·5 per cent.
Turbines	75 „
Generators	92 „
Line	95·3 „
Motors	92 „
Alternators for sectional distribution ...	93 „

Giving a total over-all efficiency of 54·2 per cent. for the Thury system.

Three-phase System.—The efficiency of the water pipes and turbines remains the same, while that of the line drops to 91 per cent., and the total over-all efficiency works out at 55·8 per cent.

It is of interest to note that one factor which has determined consulting engineer Motta to discard the further consideration of the direct current system is that there would be 104 commutators in series on the line. The main conductors are, for the three-phase system three wires, each of 240 sq. mm. cross-section, and for the direct current line four wires, two for each side, each of 140 sq. mm. cross-section. The costs given above include the interest on capital during construction, and the period of construction is assumed to be the same in each case. The final cost of energy to the municipality of Milan is calculated at 160 fr. for the three-phase system per KW.-year, including all items ; this cost is based on an assumed demand of full load continuously, that is, for 8,640 hours per year.

This assumption of continuous load is perfectly reasonable when the conditions in Milan are considered. The traction system operates for 17 hours in every 24, and during the remaining seven hours an attempt will be made to persuade factories to operate by offering exceptionally cheap rates for power ; it is noteworthy that already 3,000 KW. are supplied in this manner every night by the present power company.

To carry the peak loads, an additional steam station, with a battery of accumulators, having a maximum output of 9,000 KW. and an average of 4,500 KW. for the whole year, is being considered for the near future, but no costs have been prepared yet for this scheme.

The report finally decides in favour of the three-phase system, partly on practical engineering grounds and partly from considerations of efficiency when operating at full load.

RAWORTH'S REGENERATIVE SYSTEM FOR TRAMWAYS.

On Monday last a demonstration of Raworth's system of regenerative tramcar control was given on the lines of the South Metropolitan Traction and Lighting Co. in the neighbourhood of the Crystal Palace, which is an excellent locality for such a demonstration, owing to the numerous and steep gradients which enabled the current consumption and output to be favourably observed. One of the eight cars which are now running on the line with regenerative motors was fitted with an ammeter on the top deck, which recorded the electrical behaviour at every instant. The steepest gradient on the line is 1 in 9, indeed, a little bit is said to be 1 in 8½, and certainly over one short length the current consumption did just touch 200 amperes But over long lengths of down-grade running a steady flow of 30 and 40 amperes was sent back to the trolley wire. As our readers may know, the automatic regenerative control system is applicable to ordinary traction motors, and involves only a modification of the field winding; the car is always under the control of the motors, and must run up hill or down dale at the speed that corresponds with the position of the controller handle. Thus, if a car is running at 15 miles per hour, and the controller handle is moved back to the 7 miles notch, the inertia of the car will drive back current into the trolley wire until the speed of the car has fallen to 7 miles per hour. The car will then consume simply the current necessary to run at that speed. But if the car happens at the time to be running down a hill that would cause the car to "coast" at a speed of 12 miles per hour, the extra gravitational energy will be returned by the motors to the trolley wire, whereas on an ordinary car this extra energy would be expended on the wheels and brake blocks. Thus the regenerative car is safer than ordinary cars, because it does not even commence to run away, and accidents like that at Highgate are, we had almost said, impossible, so long as the trolley is not dewired.

It was perfectly evident that the motors did what was claimed for them, and though the line was so full of gradients, and all the Board of Trade stops were made, the absence of grinding brakes rendered the journey a very pleasant one, the movement of the car being free from jerks.

The controller, which has the external appearance of the series parallel controller, has a rheostatic brake connection independen of the power circuit.

While the life of the wheels is doubled, and the expenditure on brake blocks is reduced to a very moderate amount, these advantages are concomitant with an expenditure of electric energy from 15 to 30 per cent. less than what is required with the ordinary controller, according to the longitudinal section of the line. When a car runs downhill, it will restore energy to the full extent of the weight of the car, multiplied by the vertical descent in traversing a certain distance, less the amount of tractive effort representing rail, axle and general frictional resistance and ordinary motor loss. The car, in fact, behaves exactly as a fly-wheel, storing and returning energy which has hitherto been expended upon the destruction of wheels, rails, and other things.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer.]

"Interested" writes :—"I shall be glad if you can give me any information through the columns of your paper on the following. A corporation having obtained a provisional order for the electric lighting of their borough decide not to proceed with same, but are willing to sell on conditions which are not acceptable to a private company. What time must elapse before the company can make an application or obtain an order for the same borough, and would the corporation be able to oppose it, owing to the gas works being supported by the rates, and, therefore, likely to be less profitable if it had to compete with electricity? How can I obtain a copy of the Government Regulations of Provisional Orders?"

*** It is provided by the Electric Lighting Acts that where a company applies for a provisional order for the supply of electricity, the local authority may (in effect) veto the grant, subject, in certain cases, to the dispensing power of the Board of Trade. But if the local authority refrain from putting their own order into force within a reasonable time, the Board of Trade has power to rescind it (see Electric Lighting Act, 1882, Sec. 6 (*f*)).

Rules made by the Board with respect to applications for licences and provisional orders are published, and may be had for a small sum on application to the King's Printers.

LEGAL.

Chitty *v.* British Westinghouse Electric, &c., Co., Ltd.

(*Concluded from page* 1020.)

Tuesday, June 19th.

The hearing of this case was resumed before Mr. Justice Bigham.

Mr. MacLaren, chief electrical engineer of the defendant company at Trafford Park, Manchester, from its formation in 1899 to 1904, and previously in the service of the defendants' American company, said that on November 5th, 1902, he received a letter from plaintiff, and that was within a few days of his first interview with him. In that letter plaintiff remarked that the intermediate magnets and communicating coils were quite an after-thought, and were merely added to enable him to use copper or additional copper brushes. Those coils were the same as the auxiliary poles, and in the test on which he based his report when the machine was supposed to be under the best operating conditions, carbon brushes were always used. Plaintiff also said in his letter that the subsidiary coils, which again were the same as the auxiliary coils, were by no means indispensable. On November 14th Witness made a report on the Chitty machine and found that the method of ventilating the armature was practically the same as that employed by the British Westinghouse Co. They now knew that the method of attachment in the two Sir Hiram Maxim's machines was by riveting, but there was nothing new in that in 1902. He further reported that "the armature reaction had been further reduced by placing auxiliary poles between the main poles of the machine, but we (the Westinghouse Co.) accomplished the same result in a much simpler and cheaper manner by saturating the pole tips." "Mr. Chitty," he concluded in his report, "has not developed any special features in the design of his machine which would be of service to us." Mr. Chitty had never subsequently disclosed anything to him which had caused him to alter his opinion. On March 27th, 1903, witness made a further report on the same two machines, and to that report plaintiff, on April 18th, 1903, made strong objections and specific answers. He then reported that plaintiff's method of ventilation was no better than defendants' and not nearly so good, and in reply plaintiff claimed that his method rendered the ventilation of the armature completely effective. Further, he reported that the test showed that there was no appreciable difference whether compensating windings were connected so as to assist or to oppose commutation, and the plaintiff had abandoned the use of such windings

in his latest design. Plaintiff, in his reply, said this was a most astounding mis-statement, no such test ever having been made. He did not abandon the auxiliary poles because he had any doubt as to their value, but because he had developed his system of controlling the flux distribution, which rendered the employment of any other compensating device unnecessary. That, witness explained, was the slot system, combined with what plaintiff called his bridge pieces between the poles. Personally, he did not see the tests, but he directed Mr. Wilson, the head of the testing department, to have them made, and he reported the result to him: —"So far," plaintiff in his report added, "from my being dissatisfied with the method of auxiliary magnets, they have exceeded my expectations." Proceeding, witness said that he had never got any information from plaintiff as to the method of construction of a dynamo with which he was not fully acquainted. He attached no importance to the method of attachment of the vane to the armature plate. He was aware, before 1902, of the use of slots in the pole-piece for the purpose of preventing distortion, and a large number of machines—probably several thousands—had been so constructed by the defendant company in America. It was quite a common form of construction, well known to him. The figures in plaintiff's specification showed slots to give a concentration of the flux at the sides of the pole, whereas defendants' slots gave a concentration of the flux at the centre of the pole. The Savoy Hotel machines would give a uniform distribution of the flux over the pole-piece at no load, but plaintiff's design would not do so. It was not until this case was instituted that he first saw the diagrams attached to plaintiff's specification for slots, and the combination of auxiliary poles and slots was known to him in 1899, long before he knew plaintiff. In Prof. Silvanus Thompson's book there was an illustration of a Thompson-Ryan machine, giving a combination of auxiliary poles and slots. That was a machine which had been constructed and used largely. There was nothing in the letterpress nor in the diagram of the Thompson-Ryan machine, to indicate that the object of the slots was to prevent distortion, but, if the machine were of proper proportions, the slots would have that effect. In order to prevent distortion, they wanted the fingers of the metal pole-piece saturated with magnetic flux, and in the Thompson-Ryan machine they would get that saturation, and it would prevent distortion.

By his LORDSHIP: The windings, the auxiliary poles and the slots all went to prevent distortion.

Continuing, WITNESS said that he saw the third machine, built for plaintiff by defendants, and the fourth machine, known as the scrapped machine, in the autumn of 1903. The former at first only had the slots and not the poles, but afterwards the poles were introduced. He engaged Mr. Beyer early in July, and he came on August 1st. Mr. Beyer showed him a design with a combination of auxiliary poles and slots, and at that date he had never seen any sketch or design by plaintiff showing that combination, nor had he had any information on the subject given him by plaintiff. Mr. Beyer designed the Savoy Hotel machines. Mr. Chitty's method of attachment of the ventilation plates by punched-up lugs was applied to curved vanes, as it would not keep radial vanes as used by defendants in place. The centrifugal force would be too great.

Cross-examined, WITNESS admitted that defendants' 219 machines were constructed in accordance with one of Chitty's diagrams, but he could not state the full number of machines in which his ventilating plates were used. They had no appreciable bearing from an engineering point of view on the cost or performance of the machine. It was a manufacturing question.

Further cross-examined, WITNESS admitted that there was a marked difference between the Chitty dynamo and the Westinghouse dynamo. The object of the Chitty machine was to attain lightness with cheapness, but he did not understand that one method by which that was attempted, was by auxiliary poles; they were to reduce the armature reaction and not the weight. He understood that they did not increase the output, but the overload capacity. The Westinghouse machine was not an auxiliary pole machine, but defendants had manufactured machines with slots in the pole-piece in this country.

Mr. Justice BIGHAM: Can you explain why the Westinghouse Co. should require a licence for Mr. Chitty with reference to the machines ordered for the Savoy Hotel contract?—We received an order from the Savoy Hotel for four machines. They were quite experimental. Mr. Beyer was designing one or more, and Mr. Chitty was designing one or more. They thought it was desirable to get out a licence for Mr. Chitty, so that, in case his machine was a success, it could be applied to this order.

Continuing, WITNESS said that he was acquainted with slots before 1902, and, broadly speaking, they were of the same nature as Mr. Chitty's. The slots with which he was acquainted had not always coils in them. There was a figure on page 389 of Prof. Thompson's book showing slots in the pole-piece to reduce distortion.

Re-examined, WITNESS said that Mr. Chitty's drawings showed auxiliary poles and slots which were intended to produce an unequal distribution of the flux, whereas Mr. Beyer's design, on which the Savoy Hotel machines were built, was made to produce an equal distribution of the flux. The distribution of the flux depended upon the proportion and position of the slots.

Mr. MILES-WALKER, B.A., said he held the diploma of the City and Guilds of London Technical Institute in electrical engineering. For five years he acted as assistant to Prof. Silvanus Thompson, and helped him to prepare his book. Since 1900 he had been in the employ of the defendant company as designer. His first knowledge of slots and auxiliary poles was obtained from Prof. Thompson's book in 1896, and whilst he was in the United States the defendants manufactured machines with slots in the pole. The object was partly to control the distribution of the magnetic flux to prevent sparking, but that was not the object aimed at in the Savoy Hotel machines. According to their arrangement, the slots produced either an even or an uneven distribution of the flux over the face of the pole.

Examination continued: He came over to this country from the States in 1902, but he did not see the plaintiff until 1903. The first time he saw him was when they were testing the Hiram Maxim machines. Plaintiff made no discoveries to him or taught him anything. Plaintiff's experimental machine did not disclose anything to him novel in electrical science.

Mr. ALBERT BEYER examined, said he had been in the electrical engineering business for the last 14 years. He entered the defendants' employment on August 1st, 1903. He was formerly chief engineer of a company in Vienna. When he was employed by the defendants, he was asked to design a turbo-generator for the Savoy Hotel. That was sometime in August. His sketch showed a combination of slots and auxiliary poles. What he had shown in that drawing was well known years before to Continental engineers. It showed a combination of auxiliary poles and slots. At the time he made the sketch, he had never seen Chitty or talked to him. The Savoy machines were made from those drawings.

Cross-examined: In doing what he did at the Savoy he was not trying to have some difference between his arrangement and Chitty's. He saw Chitty's machine at the Savoy Hotel from time to time, but he did not copy Chitty. Nobody in the defendant company assisted him with the design. It was not true to suggest that the auxiliary poles and the slots were suggested to him by MacLaren.

WEDNESDAY, JUNE 20TH.

Mr. WELLS, manager of the defendant company for the past five years, said that on November 13th he had an interview with plaintiff. Prior to that date plaintiff had not given him any information about the ventilating plates, but he could not remember whether he mentioned them on the date when he first discussed with him the merits of his machine, although he knew that he did not then speak of his method of attaching ventilating vanes to the armature plate. The second agreement, dated November 14th, was entered into after a conversation at the Queen's Hotel. He had an interview with plaintiff prior to the first agreement, dated October 15th, 1902, but he did not discuss with him the method of construction of the Sir Hiram Maxim's machines. In fact, plaintiff declined to give any information about them. He arranged that plaintiff should have every facility for carrying out their agreement. The machines which plaintiff sent to them did not give results which impressed witness, and he was disposed to drop the matter, but plaintiff urged that he had not been able to get the machines properly constructed, and that if they would build a machine from his design, they would be able to get the performance he wanted. He recollected interviewing plaintiff with reference to the Savoy Hotel machines on several occasions, and at the interview on November 12th, plaintiff expressed anxiety that his turbo-generator, then well in course of construction, should be installed at the Savoy Hotel. He told him it would be impossible to decide that until the machine had been tested and proved to have merit, and that, in any case, they would have to proceed with their machines, because they could not put his machine in, even if it had merit, without an agreement with him giving them the right to use it. He further said that they would have to make arrangements with him for the use of such machines outside. The question of terms then came up, and plaintiff undertook to let them know his terms. When they received them, they were quite out of consideration. He could not remember, nor had he any record of the figures plaintiff subsequently named, but they were such as he could not recommend the company to agree to. No arrangement was, therefore, come to. He was informed that there were instructions in the Patent Bureau to apply for patents for ventilating plates for both Mr. Chitty and Mr. MacLean, and he directed that the application for Mr. MacLean's patent should not be proceeded with, because the company could not approve of its staff applying for a patent of any similar construction, unless it could be clearly shown to have been invented prior to the date of Chitty's disclosure to the Patent Bureau.

Cross-examined, WITNESS said that Chitty declined to give them any information till they had signed the agreement not to divulge anything he disclosed.

Proceeding, WITNESS said that when Chitty wrote complaining of their having adopted his designs, he sent for him and told him that they could not go on doing business with him if he took that course.

Sir E. CARSON referred to the letter written with regard to the suggested supplemental agreement with Mr. Chitty, and asked: You at that time evidently thought there was such novelty in Mr. Chitty's design that you could not use it without his consent?—I did not know whether his design was good, bad or indifferent, but I could not allow his machine to go into the Savoy Hotel without full authority, if he was understood to be the designer; and also, if it proved to be a machine of merit, we must have had authority to sell outside.

Then you did not understand it was merely a well-known design?—I do not pretend to know anything about it.

Sir E. CARSON read the postscript to the same letter, in which it was stated: "It is, perhaps, desirable that Mr. Chitty does not know that this letter has come from the Patent Bureau, as we have endeavoured all along to impress upon Chitty that we have nothing to do with the negotiations between the company and him." Do you think that an honest thing to do?—Yes, entirely honest.

Is it honest to get information out of a man on the pretence that you were not in communication?—There was no reason why the

Patent Bureau, who were our agents, should not make communication to us without any breach of confidence to Chitty. They were making application for Chitty's patent, and it was necessary that he should have full confidence in them. It was, therefore, very natural that they should not want me to tell him this.

Sir E. Carson read further: "As we find by so doing Mr. Chitty talks more freely to us, and we are able to get more information than we should otherwise do. This is of considerable value to the company, as it would be a pity if anything arises to cause an alteration in the relations between us." What was of considerable value to the company?—The considerable value to the company would be that Chitty would disclose to the Bureau information for the purpose of getting patents for him. There was possible merit in Chitty's invention, and in order that the company could get the benefit, it was necessary that all information should be put before the Patent Bureau, so that the invention could be patented in the broadest possible manner, anything which disturbed that arrangement would be detrimental to that.

Witness was further cross-examined respecting the machine which was scrapped, and the object of it having been scrapped. He said that they did not want plaintiff to take their machine to other people and make unkind comments about its construction.

Mr. Reginald Belfield, A.M.I.C.E., M.I.E.E., manager of the Westinghouse Patent Bureau, said that the Bureau was distinct from the defendant company, who were one of their clients, numbering about 20.

Cross-examined: His letter of November 11th was written for the purpose of protecting the company and Mr. Chitty.

Mr. Caichemaille examined, said he was a member of the staff of the Patent Bureau, and had been since its formation in 1900. He first saw the plaintiff in 1902, he thought in April, 1902. Plaintiff gave him an outline of the results he had attained with his machine. Chitty never explained the contents of the Hiram Maxim machines, but he thought from time to time Chitty explained his inventions to him, and said that his inventions were in the machines. Chitty had disclosed to him what was termed the divided pole-piece, and that, so far as his knowledge was concerned, was a novelty to him in electric construction. Chitty's construction of ventilating plates was also new to him.

Cross-examined: Part of his duty at the Bureau was the preparation of specifications. As far as he knew, MacLean's specification was not proceeded with. That specification was received by the Bureau about April 20th, 1903.

Mr. Letall, examined, said he was a chartered patent agent on the staff of the Bureau. On April 20th he paid a visit to the defendants' works at Trafford Park. He went into the drawing office and saw MacLean, and asked him if he had anything new. MacLean said he had a new design of ventilating plates, and he showed him a drawing of the plate. As a result of the conversation he took notes of it, and asked the British Co. whether they would like to apply for provisional protection. The specification was drafted out, but not proceeded with.

Mr. James Swinburne, examined, said he was familiar with the construction of electrical apparatus, and particularly dynamos and electric generators. At the dates material in the case, the question of getting rid of heat was practically well known. As far back as 1880, he was engaged in the construction of dynamos. He had seen the drawings of plaintiff's apparatus of February, 1903—that was the Chitty drawing, with the curved vanes on the face of the plate. The difference in method of attachment was exceedingly minute. If it was necessary to get as much ventilation space as possible, a T or H section was best. He knew the shape of the poles of the old Chitty machines. There were certain spaces in the pole-pieces. These were arranged by leaving out some of the plates in the pole-pieces. With regard to the question of slots, these were put into the pole-pieces of machines chiefly to prevent the armature getting hot, due to the field being badly distributed. It was a good thing to have the pole-pieces saturated by removing parts of them. Plaintiff had some idea that by this method he could get rid of sparking. The specification showed that he had not considered this question properly. Witness did not think that slots would prevent sparking. When reversing pole-pieces were used slots had no effect on the sparking. Reversing pole-pieces had been known about 20 years ago. He was familiar with the machines designed for the Savoy Hotel. He could not say that anything had been taken in the design of those machines from anything suggested by Chitty.

Cross-examined: He had seen plaintiff's Hiram Maxim machines, and thought they worked exceedingly well.

Prof. Silvanus Thompson, examined, said sparkless commutation, distortion of the magnetic field, conducting down the flux and auxiliary poles were matters which had been under his notice for years. They were perfectly well known to electrical designers and others interested in electrical machinery. The scientific basis of all of them was quite understood.

Examination continued: The ventilation of dynamos was a question which had been before them ever since dynamos were made, but more prominently during the last 20 years. All sorts of contrivances were adopted to get rid of the heating, and one of the commonest ways of doing it was by circulating air in the machines. Plaintiff's system was perfectly well known in the industry. Auxiliary poles were used for the purpose of getting good commutation without sparking. They were an advantage in certain types of machines, but a disadvantage in others. In high-speed machines they were a necessity. The slotted pole in itself had nothing to do with this question, because if the auxiliary pole was used and did its duty there could not be any sparking. The distortion had been already stopped by reason of the auxiliary poles. There was no difficulty in designing an auxiliary pole for this purpose, and finding how much winding on the pole was required. It was the mere application of the rule of three to the particular case in question. The use of the slots in the poles by themselves was to procure an equal distribution of the magnetic flux in order to keep down the heating of the armature. That was a perfectly known thing.

Thursday, June 21st.

Mr. Cripps addressed his Lordship and the jury on behalf of the defendant company. He said that the issue was extremely important, but it was confined within very narrow limits. The issue was whether special technical information was given by Mr. Chitty and was used by the defendants, first, as regarded a method of attachment of ventilating plates; secondly, as regarded slots; and thirdly, as regarded the combination of auxiliary pole-pieces and slots for the purpose of preventing distortion. There was nothing novel or patentable in the method of attachment by punched-up lugs with curved vanes, though the question might arise whether it was novel to the defendants; but there could be no doubt, Mr. Cripps argued, that Mr. McLean was in no way inspired or assisted by Mr. Chitty in his idea of applying flanged rails to ventilating vanes. There was just the possibility of Mr. McLean having got the information from Mr. Chitty's drawing, but all the facts, as well as Mr. McLean's own explanation, were that it was not so. He clearly had the idea prior to any disclosure made by Mr. Chitty, and he really got it from the method of attachment used with tramway rails. However, defendants never used the curved vanes by which the punched-up lugs could alone be made effective. Dealing with the second point in the case, Mr. Cripps contended that it had been successfully proved that the use of slots for the prevention of distortion had been used in a large number of machines long before Mr. Chitty came upon the scene. He submitted that defendants used slots of the design of Mr. Beyer, which gave a uniform distribution of flux, whereas plaintiff's method gave a concentration of flux at the two ends of the pole, and that Mr. Beyer knew nothing at all about Mr. Chitty. Mr. Cripps then turned to the allegation that plaintiff had disclosed to defendants the advantage of the combination of auxiliary poles and slots, and he maintained that Mr. Chitty thought he had got a system of slots which would obviate the necessity and expense of auxiliary poles altogether. It was not until there had been unsatisfactory tests of his machine that the poles were introduced, and then they were introduced in accordance with a previous suggestion by Mr. Miles Walker.

Sir E. Carson, in addressing the Court on plaintiff's behalf, declared that it would indeed have been an extraordinary coincidence if in each case—the vanes, the slots and the auxiliary poles—just as Mr. Chitty introduced the matter to the defendants, their own employés, as it was suggested, found out exactly the same things. He asked the jury to say that it was no coincidence at all, but a deliberate attempt to deprive Mr. Chitty of what he had fairly earned, by using his technical knowledge and information, and he commented strongly on the fact that until the present action was commenced it was never said that Mr. McLean gave defendants information respecting the method of attachment by punched-up lugs prior to the time they obtained it from plaintiff. There could, he submitted, be no doubt that defendants had never used the combination of the slots and auxiliary poles before, that they learned of the importance of auxiliary poles from plaintiff, and that the combination was of importance.

Mr. Justice Bigham, in summing up, asked the jury to dismiss from their minds any consideration about Mr. Chitty being a poor man and the Westinghouse people being a rich company. Justice must be done to the rich as well as to the poor, and his experience of the courts of justice was that, as a rule, it was the rich man who came off least best. They had to try to be fair to both, and to try to find out from the evidence what the truth was. Mr. Chitty had, or thought he had, information in his possession of a kind which might be of considerable use to people in the position of the Westinghouse Co. He was not at first disposed to put that information at their disposal, but after some negotiations, he determined that he would take them into his confidence in the hope and expectation of being able to turn his information to account for himself. It was, of course, of great importance to him that in pursuing this course he should not leave himself unprotected, and therefore he said to them at the outset that he must have from them a covenant that they would not divulge his secrets for their own profit. He accordingly obtained from them the document which was the foundation of the whole of the action. By it the defendants covenanted that they would not, either by their servants, agents, experts, or nominees, at any time hereafter, directly or indirectly, disclose or give information to any person or persons whatsoever as to the said improvements, the methods of construction of machines, or any special technical information communicated or ascertained in the course of the investigation and testing of the said machines, or use the same in any way whatsoever. He said the question was whether the defendants had utilised the information given to them by the plaintiff in violation of their promise not to utilise it. If the jury thought they had, then it was for them to say what damages plaintiff was entitled to.

The jury retired to consider their verdict at 3.30 p.m., and returned into Court at 3.55 p.m. with a verdict for the plaintiff for £1,600 damages. Judgment accordingly.

On Friday morning Mr. Matthews applied to have the costs of plaintiff's application for attachment made part of the costs of the action, but his Lordship, after hearing counsel on both sides on the point, refused to make any order as to those costs. Mr. Matthews further asked for costs on the higher scale, but his Lordship observed

that, by taking the case before a special jury, plaintiff had doubled the length of the inquiry, and, under those circumstances, he was not going to give him more costs than the law allowed him.

His Lordship was also asked by Mr. Matthews to express an opinion, for the guidance of the taxing master, that it was reasonable of plaintiff to have retained three counsel.

Mr. Justice Bigham: I do not think it is necessary for me to express an opinion. Defendants had four counsel, and, if you ask me whether plaintiff was extravagant in retaining three counsel, I should certainly say "no."

Gingell, Son & Foskett, Ltd., *v.* The London County Council.

This case came before Mr. Justice Joyce in the Chancery Division on Friday on a motion by the plaintiffs for an interim injunction to restrain defendants from so altering the position of their tramway lines in High Street, Whitechapel, as to interfere with the business of the plaintiffs.

Mr. Younger, K.C., for the plaintiffs, said there was an ancient hay and straw market in the High Street which had been the subject of protection by several Acts of Parliament. The Council had taken over the North Metropolitan Trams, and were electrifying the system, and in so doing they proposed to make certain alterations, and construct a junction which would cut off a portion of the hay market, and seriously interfere with the business of the plaintiffs.

Eventually the motion stood over for plaintiffs' counsel to consider the position and see if the Attorney-General would consent to be added as plaintiffs; an early day will then be fixed for the trial.

Dudley Corporation *v.* The Dudley, Stourbridge and District Electric Traction Co., Ltd.

In the Chancery Division of the High Court of Justice on Tuesday last week, Mr. Justice Swinfen Eady delivered his reserved judgment in this case.

He said: The question raised by the special case is whether the light railway which is being purchased by the Corporation from the company is to be valued upon the basis of a structural valuation regarded as a railway fixed in position capable of earning a profit, or upon the basis of the value of the railway to the company as an income-earning concern—that is, upon the capitalised value of the net profits which have been earned by the railway. By the Dudley and District Light Railway Order, 1898, the company were empowered to make, form, lay down and maintain among other railways a railway (No. 5) single line 2 miles 8·4 chains in length, the commencement and termination of which are specified in the order. The order further provides that the local authorities in whose districts the railways Nos. 1, 2, 3, 4, 6 and 7 respectively are situate may require the company to sell to them respectively the railways situated in their respective districts "upon terms of payment and fair market value thereof," in each case as a going concern, but without any allowance for compulsory purchase; and as regards railway No. 5—the one in question—the Corporation may purchase the same at the time and in the manner provided by the agreement between the company and the Corporation dated October 17th, 1898. That agreement provides by Clause 3 that the Corporation shall purchase and the company shall sell "the said railway No. 5" at a price to be settled in case of difference by the Board of Trade. The agreement does not contain any stipulation or provision as to the principle upon which the price is to be arrived at. The property to be sold, however, is "the said railway No. 5," and that is defined in the order. It is a light railway laid entirely on public roads or streets—a single line 2 miles 8·4 chains in length, between Queen's Cross and the bridge over a brook. It was urged on behalf of the company that the railway is sold as a going concern—as an income-earning concern, and, therefore, the sale must include the equipment—that the case differs from that of a tramway, as Sec. 19 of the Tramways Acts, 1870, prohibits the local authority from working a tramway which it had purchased, whereas in the present case there is no such prohibition, and the Corporation may work the light railway. Accordingly, it is said the expression "the said railway No. 5" must include the rolling stock and powers to work, or rights attached to the structure, I am of opinion that such contention is not well founded. All that the Corporation are purchasing is the "said railway No. 5"—this includes the railway *in situ*, and the stationary electric equipment or works, such as posts and wires, which form part of the "said railway No. 5," and have been duly erected or placed in position, but does not include rolling stock, nor the "undertaking." The interpretation clause in the order shows that the expressions "railway" and "railways" mean the railways and works authorised, and that the undertaking is something different. But it is the "Railway No. 5" and not "the undertaking" which the Corporation are acquiring. Several sections of the provisional order follow closely the provisions of the Tramway Act, 1870. In the Edinburgh Street Tramways Co. *v.* the Lord Provost of Edinburgh, Lord Herschell pointed out that the word "tramway" could not be read as synonymous with "undertaking," and in the present case the "said railway No. 5" cannot be read as "the undertaking of the company, so far as relates to railway No. 5." The price to be paid is the price for railway No. 5—not for the undertaking nor for powers to work the railway, nor for rolling stock, nor as compensation to the company for the loss of their right to work the railway. It was urged on behalf of the company that the present case is distinguishable from the Stockton and Middlesbrough Water Board *v.* the Kirkleatham Local Board, 1893, that their only mains, pipes and fittings *in situ* were to be purchased "by a price to be fixed, in default of agreement, by an arbitrator," whereas in the present case it is a railway which means the railway as a going concern with rolling stock and powers to work, and that the price of the railway must be ascertained upon the basis of a going concern. The answer to this argument is that the sale here is merely of "the said railway No. 5—the structure in a fixed position and nothing more." I answer the questions submitted by deciding that the proper basis of value is that put forward by the Corporation upon which the arbitrator awarded £16,548.

The company were ordered to pay the costs.

F. A. Glover & Co., Ltd., *v* The Delta Metal Co., Ltd.

In the High Court on Saturday, Mr. Pollock, one of the official referees, delivered his reserved judgment in this case. He said the action was brought by the plaintiffs, carrying on business at Clerkenwell, against the Delta Metal Co., Ltd., to recover £682 10s. in respect of balance due for work done, materials supplied, and labour in connection with a contract for the installation of electric light for the defendants. The contract was dated March 7th, 1905, and there were additions and extras. The defence set up was that there was no proper certificate as provided by the contract, that no alterations were to be done unless they were in writing, and that the work had not been completed according to the contract. Defendants counterclaimed in respect of damages sustained by them by reason of the work not having been completed in accordance with the contract. The case was one of considerable importance and some difficulty. On behalf of the plaintiffs, the point was raised that, by reason of defendants having paid into Court a sum of £250 with their appearance, they were precluded from setting up the want of a certificate as an answer to the claim. As to that contention, he did not agree. Defendants did not in any way seek to deny the contract, but they said under the contract the plaintiffs must have a certificate from the engineer, and they had not got one. That was a defence which it was perfectly competent for the defendants to raise in the action, although they paid £250 into Court. Both parties had given up their claim in respect of penalties. The contract was prepared by Mr. Jenkinson, and Mr. Jenkinson was the engineer designated in the contract. It was contended, on behalf of the plaintiffs, that the powers of the engineer under the contract were very large; that, in respect of all the complaints made by the defendants, they were bound by the decision of the engineer; that the engineer had passed the work, and that therefore defendants were bound. One of the clauses was to the effect that payment should be made on the certificate of the engineer up to 50 per cent. of the value of the completed work, and the balance on the engineer certifying that the whole of the works were completed to his satisfaction, provided always that no certificate should relieve the plaintiffs from any liability under the contract. In his opinion the clause could not mean that the engineers had any power to make an absolutely different contract from that which he had undertaken to carry out on behalf of his employer. There must be some limit to the interpretation to be put upon the question of decisions. The engineer could not put upon any clause in the contract or specification an interpretation which was absolutely inconsistent with the plain meaning of the words used in the contract and specification. Where there was any ambiguity and difficulty in construing the matter, no doubt the engineer might properly say what was the meaning of the clause, but if it was perfectly clear the clause could not bear that meaning, then the engineer had no power to do it. There was a clause in the contract that no alterations or variations might be made without the consent in writing of the engineer. That strongly showed that the engineer had no power under the clause of decision to make a new contract. The engineer had power to make certain alterations and variations, but they must be in writing. Whether under that he could make alterations carrying out an entirely different contract, it was not for the referee to decide here. His present impression was that the engineer could not. Supposing he could, then he must do it in writing, and so far as the alterations complained of were concerned, there was no writing at all. The engineer on December 11th gave the certificate relied upon by the plaintiffs. It ran:—"I hereby certify that A. Glover & Co. have, to the best of my knowledge, completed their work in connection with the contract of the 7th March, 1905, and are now entitled to payment to invoiced accounts, less £450 already paid on account. This certificate is given subject entirely to the conditions of the contract above referred to, and does not relieve Messrs. Glover from any liability whatever under this contract, and any defects or omissions which may come to my knowledge must be remedied forthwith." It was perfectly true that when in the witness-box Mr. Jenkinson said, of course he would say that that certificate was intended to be a certificate of completion to his satisfaction under the clause in the contract, but the way in which Mr. Jenkinson gave his evidence did not by any means commend itself to the Referee, and he was not at all satisfied that he was bound to take the statement of Mr. Jenkinson, especially when he considered that that statement was contradicted by other statements that gentleman had made previously. Proceeding, the Referee said he regarded the certificate as a provisional one and not a final and conclusive certificate within the meaning of the contract. But assuming that the certificate did comply with the terms of the contract as regarded payment, did the plaintiffs complete the work in accordance with the contract? The main objections raised by the defendants to the work done, had reference to the use of braided wire. It was perfectly clear to his mind that the expres-

sions used in the specification as to mains and cables could not be satisfied by the use of the braided wire which was put in by the plaintiffs, and that both Mr. Jenkinson and the contractors must have known it. He came to the conclusion that the braided wire was not in accordance with the terms of the contract. Then as to the work in general, he was of opinion that the contract had been departed from in important particulars, and had been departed from with the knowledge of Mr. Jenkinson, and of the contractors. There was a further provision that the installation should comply with the new rules of the Institution of Electrical Engineers. Upon the evidence, the Referee was of opinion that it did not comply with those rules. They did not comply with Rule 24. The dynamos provided, he was further of opinion, did not comply with the contract. He held that the certificate was not binding, because it was given in respect of work which was not carried out in accordance with the contract. There had been an endeavour to satisfy the contract by work which was entirely different to that which was provided for in the contract. There was no authority in the engineer under the contract to so vary it as to compel the defendants to accept what was admittedly very inferior and less costly work than that which was provided for. He disallowed all the extra work claimed by the plaintiffs. There had been paid on account £450 before the action, leaving a balance of £485. Defendants had paid £250 into Court, and plaintiffs were entitled to that as against the contract. There was thus left a balance of £235, and he thought defendants were entitled to that sum on their counterclaim. Defendants must pay plaintiffs' costs up to the time of their payment of £250 into Court, and the costs after that date, together with the costs of the defendants' counterclaim, must be paid by the plaintiffs.

SHEPHERD *v.* KENT ELECTRIC POWER CO.

A CLAIM against the Kent Electric Power Co., Ltd., for damages was heard at Rochester County Court on Thursday last week. Mrs. Jemima Shepherd claimed £20 damages, it being alleged that she fell down an open trap-door at the shop of Mr. Mannington, baker, High Street, Chatham, through the negligence of defendants' workmen.

Mr. A. R. NORMAN, who appeared for the defence, submitted to his Honour Judge Sbortt that the action had been misconceived, inasmuch as it should have been brought against the owner of the shop instead of the Kent Electric Power Co.

It was contended by Mr. W. A. WATSON, for the plaintiff, that the company were negligent in leaving the trap-door open, although the shopkeeper was also by-law responsible for any acts committed on his premises in which he himself had been guilty of neglect.

During an adjournment the parties came to terms, it being arranged that plaintiff should be paid £13 10s.

PARLIAMENTARY.

London Outer Circle Railway.

(*Concluded from page* 1023.)

WEDNESDAY, JUNE 20TH.

MR. BALFOUR BROWNE, K.C., addressed the Committee on behalf of the Great Eastern Railway Co. He contended that the line, if constructed, would never be a success. There was no guarantee that the money would be raised, for none of the commercial gentlemen had said that they would agree to support the Bill financially.

The CHAIRMAN remarked that, so far as those gentlemen being able to find the money was concerned, the Committee were satisfied that they could do so, but it must be shown that the line would have commercial possibilities when constructed.

Continuing, Mr. BALFOUR BROWNE said that he did not say one word against those gentlemen. He knew very little about finance, but their names were familiar even to his country ears. The fact was that the Bill was a contractors' Bill, and nothing else, for two contractors had the control. The capital was put at £6,000,000, and in order to pay 4 per cent. it required £240,000 a year. Taking the promoters' figure of £250 a week, multiplied by 52, and even giving them 40 miles—and the real figure was 33 miles—the total would be £520,000. But the Committee had had evidence that, instead of 50 per cent. being the cost of working expenses, they worked out to at least 60 per cent. If that were so, the total would be £208,000, which would not give 4 per cent. In conclusion, he asked if the Committee was satisfied as to there being any real public want for the line. It was a line laid out to serve other railways, but if there were no junctions it would not pay. As for any local traffic, he did not believe that there would be sufficient to justify the construction of the line, and on all points he asked the Committee to reject the preamble of the Bill. If the line were terminated at Tottenham the Great Eastern, although they did not want a junction, would, if the Committee so desired, give facilities for one.

Mr. CRIPPS, K.C., then replied for the promoters. He said that at the outset he might say that the promoters could not accept a line cut off at Tottenham. It would be tantamount to the rejection of the scheme altogether. Coming to a consideration of the opposition of the various railway companies, he said that it really amounted to an endeavour to keep out another factor in the railway politics of London. If any delay were made in constructing the line, it would mean that the cost of the land would have gone up so as to make it prohibitive. Already the cost of land was £30,000 a mile. The railway companies would in the future render the construction of the line practically impossible. Undoubtedly the line would be of great public advantage, and why should not the promoters be allowed to carry it out? They were men of financial ability who considered that the line would be successful, and as it was a line which would not injure anyone, there was no reason why it should not be made. There were no landowners objecting to their land being taken.

Mr. READER HARRIS, K.C., said that Bowes Park Estate objected to the 90 years reversion.

Mr. CRIPPS said that that was so, but they were the only petitioners on that ground. Continuing, learned counsel proceeded to deal with the question of the shares, and contended that the contractors had not so much control as has been made out. He concluded by asking the Committee to pass the Bill.

The CHAIRMAN said that the Committee would reserve their decision until Thursday.

THURSDAY, JUNE 21ST.

Sir Geo. Doughty, the chairman of the Committee, announced the decision of the Committee in regard to this Bill.

He said that the Committee had given very careful consideration to the Bill, and he desired, on behalf of himself and his colleagues, to thank the counsel and the witnesses on both sides for the great assistance they had given them during the number of days they had been considering that intricate and, he might say, somewhat difficult question. The Committee had endeavoured to consider the question very largely from the point of view of the general advantage to the public, and the question was whether such a line from west to east had in it any great public potentialities, or any advantages to the public which were not met now, or were not likely to be met in the near future. The Committee had also had to consider the question of the method of promotion, and although they did not cast any reflections on the promoters, the fact remained that the Bill was very largely a contractors' Bill; and presuming that the estimates given to the Committee when they got to the financiers did not meet with their approval, the Committee had had to consider whether they would be justified in hanging up any possible future extension in the district covered by the Bill. Whether there were any financial or commercial possibilities in the scheme was another matter they had had to consider. What amount of traffic would the line get, and what would be the value of the local goods traffic? The Committee had considered the estimates put in by Mr. Sellon and Mr. Conacher, and they were of opinion that they erred by being too generous. They (the Committee) were afraid that, if the line was constructed, it would not pay within 20 years more than one-third of the amount which had been estimated. Therefore, and it was with regret, the Committee had come to the conclusion that the preamble of the Bill had not been proved.

L.C.C. Electric Supply Bill.

(*Continued from page* 1023.)

TUESDAY, JUNE 19TH.

The first of the independent expert witnesses was called—Prof. ARNOLD LUPTON, M.P., the mining engineer. The Professor placed before the Committee an elaborate statement of a scheme for transmitting electric power from the coalfields, prepared by two engineers, Mr. B. H. Thwaite and Mr. W. H. Booth. Witness said he had gone through all the estimates and calculations, and considered that, taken as a whole, they were substantially correct. The proposal was to use a current at 10,000 volts, and to bring it into London over a distance of 120 miles. If London were supplied by electric generators of, say, 1,000,000 KW. average load, the greater part of the railways, tramways and factories could be driven by this current, also all the required electric lighting, heating and cooking supply could be given. The energy for heating buildings would be supplied at 1d. per unit. One ton of coal used at the coalfields generator would do as much heating as four tons in an open firegrate. One ton would also do as much factory work as 3 tons, and in some cases 6 tons, burned under steam boilers in London. The proposed supply would, therefore, take the place of the greater part of the coal now burned in houses and factories, and on railways, but would not stop the gas works. In the scheme which he laid before the Committee, it was proposed to use gas engines driven by producer gas. They would use only half the coal used by the best steam engines. They would use cheap slack, and the cost per ton would be only two-fifths of the cost of the fuel used by London electric generators, taking average prices. The sale of by-products from the coal would realise 2s. 6d. per ton. The land on which the generating station would be erected would be cheaper, and the saving in rates on about 100,000 KW. capacity would be about £45,000 a year, or about 9s. a year per KW., or 0·033d. per unit sold. At 60,000 volts it was cheaper to carry energy by wire to London, than to carry it as coal on rail or by ship. Assuming for sake of argument a plant at the coalfields of 120,000 KW. capacity, delivering to the London purchaser in bulk 104,000 KW.—say, 320,000,000 B.T.U. a year—each B.T.U. would require 5 lb. of coal if generated by steam plant in London. That equalled about

430,000 tons of coal a year. The following was the cost of transmitting the current from the coal-field generators :—

Interest on cost of copper cables at 4 per cent. per annum	£24,000
" " posts at 5 per cent.	6,000
" " extra plant to cover loss in transmission at 5 per cent.—	
Generators	9,500
Transformers	2,500
Wayleaves, &c., and underground cables at 4 per cent.	16,000
Wages, attention to line, &c.	5,200
Cost of generating current lost on line	11,105
Cost of materials for repairs and renewals	5,200
Wages, and materials of transformers	2,500
	£82,095

This showed a saving on the lowest cost of carriage to London of more than £25,405 a year. If the load factor were increased the interest on the cost of the electric transmission line would remain stationary, but in the case of carrying coal to London there would be an increase.

The electric generating station might be in Derbyshire, Nottinghamshire, Leicestershire, Warwickshire or Staffordshire. The cost, including land, buildings, &c., was estimated at £2,310,000, and the cost of the transformers, cables, wayleaves, &c., at £1,170,000. The total capital, therefore, would be £3,480,000, the total capacity being 132,000 KW. The loss on the step-up transformer at full load was taken at 4 per cent., and the loss on the step-down transformer at the same rate, but only half the loss was chargeable against the scheme, because the London works would have to transform their current, so that the total maximum loss would be about 6 per cent. The average loss on the line would be probably less than 10 per cent.—perhaps only 5 per cent. Witness went on to compare the scheme with that of the L.C.C., which showed a total cost of £3,268,055 for a bulk supply of 85,500 KW. Even deducting the cost of transmission, the cost would be £2,079,868. The total cost of the coalfields scheme was £33 7s. per KW. delivered in London, and the total capital cost of the L.C.C. scheme was £24 10s. He was of opinion that the L.C.C. estimate was too low, and that the total cost of that scheme would work out at £27 10s. per KW. The working cost per annum of the coalfield scheme was £174,719 for 320,000,000 units a year. The total cost of the net units delivered to bulk purchasers in London was £415,019. The L.C.C. annual working cost was £348,237, and the annual capital cost £144,625—a total of £492,862.

Mr. W. H. BOOTH was then called, and gave evidence in regard to the working of gas engines, and Mr. B. H. THWAITE and Mr. WM. DOIG also gave evidence.

Mr. ROBERT HAMMOND, the consulting electrical engineer to the L.C.C., was called, and criticised the figures given in the foregoing scheme. Witness had not concluded his evidence when the Committee adjourned.

London County Council Tramways.—Fresh petitions have been deposited in the Private Bill Office of the House of Lords against the L.C.C. Tramways Bill by the Battersea Borough Council, the London and North-Western Railway Co., the Metropolitan District Railway Co., the London Omnibus Owners, Poplar Borough Council, Wandsworth Corporation, City of London Corporation, &c.

Bury Corporation Bill.—Mr. J. W. Wilson's Select Committee of the House of Commons has passed the preamble of the Bury Corporation Bill, which is an Omnibus Bill containing, amongst other things, powers to construct six lengths of tramway of a total length of about three miles, and powers to make agreements with neighbouring local authorities as to the purchase, sale, leasing and working of tramways. The estimates were £54,000 for the construction of tramways, £12,500 for electrical equipment, and £45,000 for the extension of the electricity works. The Committee sanctioned the construction by the Corporation of a tramway 1 mile 1 furlong in length outside the borough, and they allowed a period of seven years within which to construct a portion of another tramway within the borough.

South Wales Electrical Power Distribution Bill.—On Tuesday last week the Standing Orders Committee of the House of Commons decided that in the case of the above Bill, the Standing Orders might be dispensed with, and the promoters allowed to insert an additional provision, providing that the consent in writing of three-fourths of the existing debenture stockholders and the approval of three-fourths of the existing shareholders of the company at a meeting specially called for the purpose, was proved before the Committee on the Bill. The additional provision is for power to create and issue first debenture stock ranking in priority to the existing debenture stock, &c.

Nottinghamshire and Derbyshire Tramways Bill.—This Bill, which extends the time limited by a former Act for the purchase of lands and for the construction and completion of tramways and street widenings, came before the House of Commons Committee on Unopposed Bills on Friday, and was ordered to be reported for third reading.

Metropolitan Railway Bill.—This measure came before Lord Onslow, chairman of Committees of the House of Lords, on Monday, when it was reported for third reading. The Bill, which has already passed the Commons, proposes an extension of the limits of deviation fixed by the Act of 1902 for the improvement of the company's station at Baker Street. Power is also taken to acquire additional lands at Ickenham for the construction of a station, goods yard, &c.

District Railway Bill.—By this measure, which was before Lord Onslow on Monday, the company take power to extend their subway at South Kensington to the Albert Hall, to make certain junctions at Whitechapel and Acton, and to raise £900,000 with the usual one-third borrowing powers. The Bill was reported for third reading.

Macclesfield and District Tramways Bill.—The Chairman of Committees of the House of Lords has reported that all opposition to this Bill has been withdrawn, and the orders to refer it to a Committee have accordingly been discharged.

Second and Third Readings.—In the House of Commons on June 21st the West Yorkshire Tramways Bill was read a second time, and on 22nd inst. the Buenos Ayres Grand National Tramways Bill was read a third time. In the House of Lords on June 22nd the London County Council (General Powers) Bill and the London County Council (Tramways and Improvements) Bill passed the second reading. The Folkestone, Sandgate and Hythe Tramways (No. 2) Bill was read a third time. In the Commons on 25th inst. the Derbyshire and Nottinghamshire Electric Power Bill was read a third time. The Cumberland Electricity and Power Gas Bill was read a second time.

Royal Assent.—The Royal Assent has been given to the following Acts:—

Electric Lighting Order Confirmation Acts, Nos. 1 and 2, 1906.
Mersey Railway Act, 1906.
Preston, Chorley and Horwich Tramways Act, 1906.
South Lancashire Tramways Act, 1906.

Shropshire, Worcestershire and Staffordshire Electric Power Bill.—Major Dunne, Mr. Napier, Mr. Brece, Mr. W. H. Lever and Mr. J. Ward have each given notice of their intention to move the rejection of the above Bill on second reading.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Efficiencies of D.C. and A.C. Motors.

It is rather surprising that no firms have as yet come forward with figures for the efficiencies of their motors, but it may be that for the sake of diplomacy they do not wish to enter into controversy.

I think there is no doubt that the figure quoted by Mr. Hobart in his letter, which appeared in your issue of the 1st inst., is a fair representative figure for quite 80 per cent. of the many manufacturing firms. Of course, it is likely that there are a considerable number of smaller firms whose motors show figures more nearly in accordance with Mr. Fynn's statement—as a matter of fact, many such do not have to stand any test or specification, and some of the small firms do not retain a designer on their premises, and their machines may be very poorly standardised; but there are at the present time such a large number of first-class electrical firms turning out really good products, that it is quite safe to say that 80 per cent. of the firms would come up to the figure quoted by Mr. Hobart.

The figures in the following table, which have recently come to hand, are worth consideration :—

Name of firm.	Rating.	Full load efficiency.	Remarks.
Lancashire Dynamo and Motor Co.	5 H.P.	84 %	Mean of 6 machines.
	6 H.P.	85 %	
	7 H.P.	83·7 %	Mean of 2 machines.
Vickers, Sons and Maxim	5 H.P.	82·5 %	
	6½ H.P.	84 %	
Scott & Mountain	5·5 H.P.	83·6 %	Standard machine.

These are not predetermined figures or catalogue values, but are from test sheets selected at random.

It is not, in my opinion, worth the trouble of getting more figures, but I have by me another sheet of tests of motors of a well-known make, in which the efficiencies average 84 per cent. for 5-H.P. motors.

If the efficiencies of continuous-current motors are as low as we would be had to believe, it is not probable that motors can be of the weights shown in Mr. Hobart's curves (see *Journal I.E.E.*, Vol. 36, p. 375), and still be within the ordinary limits as to temperature rise. But as these weights are quite in accordance with practice, the efficiencies cannot be so low, or the motors would run abnormally hot.

Mr. Fynn states (*Journal I.E.E.*, p. 378) that "When comparing a continuous current with a single-phase commutator motor, it must never be forgotten that the former is in the prime of life, whereas the latter is only just out of the nursery."

Of course nobody will dispute this, but it seems to me that if the continuous-current motor has only reached such a stage as would appear from Mr. Fynn's statements, its

"prime of life" indicates a very poor state of health, and designers are certainly not to be congratulated thereon.

As Mr. Hobart said (*Journal I.E.E.*, p. 375) :—"It seems a pity to disparage endeavours to get a good single-phase motor, for it is a very desirable end to attain," and we are glad to note that Mr. Fynn's motors weigh less than ordinary single-phase motors of 1903. It is, however, surely not fair to effect comparisons on misstatements regarding the one type of motor, and the development of the other type will not be in any way furthered by such comparisons.

I tender my apologies for taking up so much of your space over such a comparatively small point as this, but it is desirable for the truth to be stated on such a point, and the matter settled in accordance with facts.

A. G. Ellis.

London, W.C., *June 26th*, 1906.

In your issue of the 1st inst. Mr. Hobart calls attention to the surprising differences of opinion which appear to exist as to the relative efficiencies of various motors. One would hardly have thought it possible that there should be any question at the present time as to the efficiency of D.C. motors, but as such is the case I take the opportunity of mentioning the efficiencies we have found for various motors with our special motor testing plant at the Northampton Institute. The values may be taken as correct to within ·5 per cent. (probably ·2 per cent.) in all cases.

COMPARISON OF D.C. SINGLE-PHASE AND POLYPHASE MOTORS.

—	Maker.	B.H.P.	Type.	Voltage.	Speed.	Efficiency. Half-load.	Efficiency. Full load.	Temp. rise °C.	Weight, lbs.
D.C.	Laurence-Scott	2	Shunt	100	1,040	68	77·5	44·5	398
	E.C.C.	5	,,	100	700	78	36	36	—
A.C. Single-phase 50 ~	Heyland	4	Induction	100	1,445	71·7	77·3	—	285
	Fynn	5	Commutator	200	1,400	56	60·6	—	451
	Lahmeyer-Schuler	5	,,	110	970	55·6	66	—	680
A.C. 3-phase 50 ~	A.E.G.	3	Wound rotor	60	1,430	78·5	78·3	—	300
	E.C.C.	11	Cage rotor	220	950	88·9	88·3	46	713

The Fynn motor, above mentioned, was kindly lent by Messrs. Witting, Eborall, but was only of the 1902 type, so that it is not representative of the latest form. The others have been purchased and are in no way special.

Although I am personally very much interested in alternate current motors, I consider it useless to pretend that the efficiency of any single-phase motor at present approaches that of a good D.C. machine. Mr. Hobart's comparison of the efficiencies appears to me in no way exaggerated, and unless something radically new in single-phase motor design is arrived at, it will probably remain correct for a considerable time. On the other hand, the two or three-phase motor gives the most excellent results, and this, combined with its simplicity of construction, makes it the real rival to the D.C. shunt motor. I must confess that I cannot see any reason against the more extended use of the two-phase motor if supply companies would follow the example of two-phase generation, as in the case of the Metropolitan and County of London Companies. The second phase could always be supplied to a power consumer.

In view of the great importance of this question of the running and starting qualities of various types of motors, I propose publishing shortly a detailed account of the tests we have made. In the meantime, if any designer of single-phase motors has produced a motor which can improve upon the above figures, I shall be pleased to hear from him with a view to including tests of his motor with the others.

Charles V. Drysdale.

Northampton Institute, Clerkenwell,
June 20th, 1906.

Electrolysis and Joint Boxes.

The above article has been criticised by "Mains Engineer" and "Sero sed Serio," and as writer of the article may I reply to them? The former has been dealt with by Messrs. Verity's letter in last week's issue, and everyone must agree with his admonitions regarding watchfulness in mains work. "Sero" is denunciatory, and occasionally pointless, which is natural this hot weather.

His allegation that I am out of touch with the best practice shows his lack of appreciation of the general practice. "The immaculate need no priest."

Regarding joint-box troubles: he must surely hold a brief for joint-box makers. *Whose brief?*

Lead sleeve tee joints are so little used as to justify my remark as to their "improper" use. Every mains engineer knows their deficiencies.

"Sero" says that 15 years ago "electrolysis" was quite a common term. So common, indeed, that in all the following books, papers, &c., which I have just turned up for the purpose, there is *no mention of the word* :—"Electric Cables and the Distribution of Electricity," by Stuart Russell, 1892; "Notes on Designing a System of Mains," J. H. Rider, 1894; "Concentric Cables," J. Hetherington, 1897; "Distribution of Electricity," C. H. Wordingham, 1897; "Distribution of Electricity," C. D. Taite, 1899; "Notes on Cheltenham Mains," H. Kilgour, 1899. There are others, but these few will perhaps suffice to prove "Sero's" inexactitudinariancy.

It was kind of "Sero" to corroborate my statement that "there are not many" perfectly bonded systems, by saying "*there are systems.*" This and the two previous paragraphs are equally pointless as arguments; and if he wants more details of the joint boxes mentioned let him go to the makers and inquire.

"Sero's" last point as to the use of wooden bushes being damned for iron boxes and blessed for glass is a proof that he does not grasp details. Such bushes were condemned as *insulators*, but on boxes made of an insulating material which cannot be bored for glands they would only be used as *bushes*, and as such are quite correct. Again, packing is only recommended where oil or a semi-solid compound is used inside the box, which filling is preferred by some engineers.

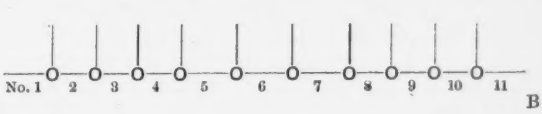
As to electrolysis being "imaginary," surely "Sero" is a disciple of Mrs. Eddy.

In conclusion, may I mention that I am not connected with either of the firms of Bullers or Veritys, whose names were mentioned in my article.

The Writer of the Article.

I thank Mr. Cotterell for his reply to my letter, but would rather have had the opinion of some engineer who has had glass joint boxes in use, for the reply coming from the owners of the patent looks very much like a case of "blowing one's own trumpet;" at the same time I fully appreciate the endeavour made by Mr. Cotterell to bring his goods before the public eye.

The suggestion of the L C, T C distributor not recording the "earth" at the supply station, being in no way different from conditions met with on most networks is, I think, a very bold assertion to make, and I can only say that the engineers in charge of such networks are not to be envied or copied. I do not quite see that the periodical testing which I advocated in the ELECTRICAL REVIEW of June 17th would cause any such fault to show up, for the testing which I meant was the testing of the mains in, say, two or three sections, or as can be conveniently split up, or even testing the whole of the mains under working conditions, whereas the only way to test if every lead or metallic sheathing was insulated, each from each, would be to test directly on to



each piece of sheathing. For example, let A B represent a length of L C, T C distributor with services off as shown, each joint made with a glass joint box. Commence testing at A to lead of No. 1, then to test to lead of Nos. 2 and 3 it would be necessary to open down over the joint between these two sections, and so on all along the distributor; and wherever there is a joint or distributor, feeder and for all other mains.

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Consider doing this on a system with only, say, 200 to 300 services, it would be a task which, to do periodically would, I am sure, make the distribution costs very remarkable; and, as Mr. Cotterell says a little lower down in his letter, that joints are mainly forgotten, it would make the task infinitely more difficult, whereas with a bonded system even if a joint did happen to be forgotten (which is not quite so often the case as Mr. Cotterell appears to think), one could be more certain that every section was being tested.

I was sorry to note that the question of leadless cables was not gone into, as I think it is one of great importance to the central station engineer; it would be rather interesting to know where the leadless cables have been in use for about 20 years, certainly not many in the United Kingdom, for according to the ELECTRICAL REVIEW's list of supply stations, only about 12 have been open this period, and all of those have not leadless cables.

Finally, I consider that any attempt made to interrupt the continuity of the sheathing, means the breaking of the communications between the mains and those in charge, and this, of course, should be avoided.

Mains Engineer.

Street Lighting.

My letter, which you printed in your "Correspondence" columns last week, having produced two letters from gentlemen who evidently do not know how to apply the laws I referred to, I will endeavour to bring them within the limits of their comprehension by stating them a little more fully.

In the case of reflectors, perhaps they will be able to understand the two following extracts from Mr. A. P. Trotter's paper read before the Institution of Civil Engineers in 1892: "The light reflected from a dead white surface is diffused over a whole hemisphere with a power very nearly proportional to the cosine of the angle of reflection." And later on he further states that "The usefulness of a white reflector in practice depends almost entirely on the solid angle which it subtends to the light, and not, as is sometimes imagined, on its absolute dimensions."

If Mr. Tracey will apply this rule to the reflector he thinks worthy of suggestion, he will find that the solid angle is very small, and, therefore, the efficiency of the reflector is low. For the same reason, "Ubique" can ascertain for himself that, in order to obtain the highest efficiency from a reflector, some of the light must pass through the source, but, as it is a comparatively small amount, the efficiency is not reduced to anywhere near the same extent as would be the case if these simple laws were disregarded.

"Ubique" not only appears to lack good manners, but also intelligence, therefore it is necessary to explain that in comparing the absorption of different sized globes of the same form and material, the superficial area and the quantity of glass used are the important factors; surely he can understand that not only the thickness of the glass, but also its average distance from the source of light, is controlled by these factors. But probably, as he talks about the amount of light absorbed from any ray, he has not acquired even an elementary knowledge of the subject.

Dulciter Dormans.

Flame Lamps.

We notice a letter having reference to "Flame Lamps" in the "Correspondence" column of your issue dated June 15th, from which it would appear that certain members of the trade, searching for a simple design of flame lamp, have come to the conclusion that "lamps in which the carbons were fed by gravity and supported by a stop offered the best solution of the problem" set to supply a lamp which was both simple and reliable.

Now, Sir, perhaps we may be allowed to point out that our Juno flame arc lamp, which has been on the market for the past ten months, has already solved the problem. This lamp was described in your issue of March 13th, and as may be seen by a reference to this description, the lamp is of the type in which the carbons are supported by a cheap and easily renewable stop, and fed by gravity.

It is not necessary, therefore, for anyone to wait until the firm alluded to have had time to complete their design, as we are in a position to supply immediately flame lamps, which have no shunt coils, wheels, sliding rods, clockwork, dash-pots, brakes, clutches, or other mechanism likely to get out of order, the consequence being that repairs are reduced to a minimum.

In conclusion, we would say that we are prepared to send one of these lamps to any responsible prospective purchaser on two weeks' trial, the understanding being that, if the lamp does not operate exactly as represented by us, owing to any defect in the material or workmanship, it may be returned.

Johnson & Phillips, Ltd.

Charlton, *June 19th*, 1906.

Flexible Cords.

With reference to the letter of Mr. Charles J. Hall in the ELECTRICAL REVIEW issued on June 22nd, there is, of course, no difficulty in covering flexibles so as to render them flameproof, where such a construction is considered advisable. We may say, however, that we have had very considerable experience of the I.E.E. flexible, but have not yet come across the fault mentioned by Mr. Hall. We venture to suggest to him that the fault can be almost, if not quite, eliminated by a suitably designed cord-grip, so that sharp angular bends at the lamp-holders are more or less an impossibility.

The London Electric Wire Co., Ltd.

London, E.C.,
June 26th, 1906.

A Protest.

On three recent occasions, having replied to advertisements in your "Appointments Vacant" columns, I have been favoured with circular requests asking me to take up an agency (*i.e.*, tout) for an insurance company, and for a teaching by correspondence institution. On each occasion the wording of the advertisement to which I replied was quite misleading.

These methods may be considered smart business by the companies concerned, but they are very annoying to those who have wasted time in replying to the advertisements. Nor does the annoyance end here, for these companies continue to pester one for weeks after with additional circulars and letters in the hope of inducing the recipient to take up their agency, which, as every one knows, is not in the true sense an agency at all.

I enclose one of these letters which I have just received; the last paragraph, "Trusting that you will decide to act as one of our representatives, and will in a short time qualify for promotion to a higher position" is a beautifully humorous piece of impertinence.

The methods of these companies in advertising in the technical Press, are, to say the least, not straightforward. Even though a company does not want to give its name, it should at least state what its business is, and what the nature of the vacancy which its advertises.

As I may have many fellow sufferers amongst your readers, I should be greatly obliged if you could insert this letter in your paper with a view to having the question ventilated.

A.M.I.E.E.

Coherers.

With reference to the coherer phenomena cited by your correspondent, Mr. C. A. Hill, in your to-day's issue, I may at the outset state that he is not correct in assuming that no cohesion under any circumstances takes place; it can be effected under certain conditions. The explanation is as follows:—

It is a well known fact that a closed oscillatory circuit is a more persistent vibrator than an open one; consequently the former will only respond when it is practically in tune with the exciter, whereas the open circuit will respond—although perhaps feebly—to almost any untuned exciter. Thus the coherer with its short flexible leads disconnected is a small open circuit resonator and responds readily to waves of almost any length, the shorter ones giving the best results.

If, on the other hand, the leads are joined, the result is practically equivalent to a small Hertzian resonator which only responds when constructed with due reference to the wave length of the transmitter.

If an oscillator of small dimensions be used it will be found that the coherer can be affected even when its wires are joined together and placed at the node of the wave.

If I can be of further service to your correspondent I shall be pleased to hear from him and to go into the matter more fully by correspondence or otherwise.

Maurice Child,
Instructor in Wireless Telegraphy,
London Telegraph Training College.

June 22nd, 1906.

Inaccurate Electricity Meters.

A large consumer's meter having been in use for a number of years, it was decided to change same for one of the most up-to-date type. The old meter, on being tested, was found to be slow, and would not start until four 16-C.P. lamps were switched on. This may have been going on for some time, as the meter readings were quite uniform—that is to say, they did not justify a special "picking out" of this consumer.

The bomb burst when he received his first quarter's account as registered by the new meter, which was, of course, much higher than most of any preceding corresponding quarters—so much so, that the consumer disputes the account, and says the meter must be wrong. In order to try and satisfy him, we make another elaborate test on his premises, and find that the meter is correct. We explain to him all about his old meter and results of the various tests made.

He is by this time evidently getting tired of us and our tests, &c., so sends his account to us, less 12½ per cent., to settle the matter. For more reasons than one we do not wish to upset this consumer. If the 12½ per cent. is taken off, it is very poor satisfaction to us, considering the trouble we have taken, and also reduces electrical metering to an absurdity.

He will also inform his friends that 12½ per cent. will be knocked off similar accounts, if they only persist in their dissatisfaction, while, at the same time, if we go for our "pound of flesh," we shall in all probability lose this consumer.

We ask any of your readers what they would do in a case like this?

Only One Case.

June 23rd, 1906.

A Grievance.

Our attention has been drawn to a letter in your issue of the 15th inst., headed "A Grievance," and signed "Rheostat, Walthamstow." From the wording of this letter it might be assumed that the firm referred to is this company. We should like to say, however, that this is not the case. The feeling between ourselves and our employés is of the most cordial kind.

Bray, Markham & Reiss, Ltd.

Walthamstow, *June 21st*, 1906.

The L.C.C. Greenwich Power Station.

Have you seen in to-day's *Daily Mail* the reference in its "leading article" to the "turbine generator"? It is there stated that "it is an astounding fact that, though the turbine engine produces little or no vibration, and is by far the most economical generator of electricity, the Council should have installed obsolete or obsolescent reciprocating engines at Greenwich." Truly astonishing; but still more surprising is the ignorance displayed by the writer of the article. Will the lay Press, and this journal in particular, ever sufficiently understand the rudiments of technical subjects to render impossible the dissemination of such stupid blunders?

X. Y. Z.

June 22nd, 1906.

[We appreciate our correspondent's delicate irony. That the lay Press should for once have got hold of the right sow by the ear is certainly a remarkable fact. Still, is it quite kind to chaff them even when they are in the right?—EDS. E.R.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

VISIT OF KINDRED INSTITUTIONS.

THE following is a list of the visitors:—

ASSOCIAZIONE ELETTROTECNICA ITALIANA:—Messrs. E. Barni, C. Barzano, M. Bonghi, G. Brunelli, U. Callegari, G. Carminati, A. Chizzolini, C. Clerici, E. Conti, V. Crosa, C. Curti, D. Levi Da Zara, E. De Benedetti, E. De Strens, A. Ferrari*, E. Ferrua, N. P. Frassetto, G. Gadda, G. T. Giorgetti, T. Gonzales, G. Locatelli, C. Loria, G. Luzzato*, Dr. S. Magrini, Messrs. F. Minorini, C. Moretti, Prof. S. Pagliani, Messrs. L. Pizzi, L. Pontiggia, E. Rieti, L. Rizzoli, L. Salvadori, G. Semenza (general secretary and delegate to International Electrical Commission), G. Stramezzi, Gian Carlo Stucky, A. Venzaghi.

SCHWEIZERISCHER ELEKTROTECHNISCHER VEREIN.—Messrs. C. Arquembourg, M. Aubert*, Emil Bürgin, Paul Dapples, Alfred Diener, Prof. J. L. Farny (delegate to I.E.C.), Messrs. W. J. Favre, L. Flesch, A. Girard, — Guillot, Dr. W. Hess, Messrs. J. Martin, E. Respinger, A. Ritter, K. P. Täuber (delegate to I.E.C.).

CANADIAN ELECTRICAL ASSOCIATION.—Profs. L. A. Herdt, R. B. Owens.

SOCIETE INTERNATIONALE DES ELECTRICIENS.—Messrs. R. Alliot, A. Beghin, P. Biles, Paul Boucherot, M. Bouchet, E. Brylinski, E. de France, R. de Journel, R. Dongier, M. J. Grosselin, M. W. Herrero, E. Hospitalier, A. Labour, A. Legouez, L. Lorin, P. J. J. Marsalès, M. C. E. Mestre, L. L. V. Mouchard, K. Sosnowski.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—Messrs. F. G. Bolles*, H. M. Brooks, M. Brooks, Jas. Burke, W. C. Burton*, F. J. Chisholm, J. R. Crawford*, F. B. Crocker* (delegate I.E.C.), T. Dwight, C. L. Edgar, F. H. Gale, K. Hedin, R. O. Heinrich, W. S. Hunt, J. P. Jackson, Dr. A. E. Kennelly (delegate I.E.C.), P. Letheule, J. W. Lieb, J. W. McCrosky*, C. O. Mailloux (delegate I.E.C.), W. W. Miller, C. H. Mitchell, E. J. Murphy*, C. A. Perkins*, R. W. Pope (secretary), E. S. Rein, E. F. Schnuck, C. H. Sharp, J. H. Siegfried, A. Simon, Prof. Harrison W. Smith, E. W. Stevenson*, F. H. Taylor*, S. S. Wheeler, R. Wickander, W. H. Wiley, C. T. Wilkinson, A. E. Winchester*.

VERBAND DEUTSCHER ELEKTROTECHNIKER. — Dr. von Baeyer, Dr. R. Blochmann, L. Brandes, F. Brunner*, G. Dettmar, (general secretary and delegate I.E.C.), Prof. Elliot, A. Eymess, R. Eymess, Prof. Feldmann, F. Fuchs, Dr. Gebrcke, — Gentzsch, Dr. B. Glatzel, E. Goedecker, — Haeffner, Dr. Kath, — Khern, R. Kohler, E. Laszlo, A. Lynen, Dr. P. Meyer, H. Montanus, Prof. Niethammer, Messrs. O. Queisser, Julius Raacke, — Reichenheim, E. Rühmkorf, H. Scholz, O. Schöne, — Somborn, — Vogelsang, — Wachsmann, — Witzell, — Zimmermanns.

ELEKTROTECHNISCHER VEREIN. — Messrs. A. Anthes*, Dr. N. Artemieff, R. Boy, W. Fellenberg, F. Feyerabend, A. Heilborn, M. Hermann, — Herzog, E. Jasse, E. Kempf, A. Kodermatz, G. Larson, Dr. Max Levy, Messrs. F. Lux, R. Moser, E. Naglo, J. Richter, Dr. E. Rosenberg, A. Rothert, H. Sauer, O. Schaefer*, J. Schmidt, Leo Schüler, F. Schüler, Prof. Sengel, L. Spängler, Joseph Vater, J. Wagner, E. Ziehl.

REPRESENTATIVES OF FIRMS (GERMANY).—Dr. A. Berliner, Dr. E. Budde (president V.D.E., and delegate I.E.C.), Mr. W. von Siemens, of Messrs. Siemens & Halske; Mr. F. Deutsch*, Prof. Klingenberg, Mr. S. Roos, of the Allgemeine Elektricitäts Gesellschaft; Prof. J. Epstein, Mr. — Zschaeck, of Messrs. Lahmeyer.

* London visits only.

The foreign visitors numbered 181, and were accompanied by 38 ladies. A large number of members of the British I.E.E.—given in the official list as 252, in addition to 48 at Birmingham, 35 at Leeds, 14 at Manchester, and 8 at Newcastle—were to take part in the International meeting, but only 38 British members were set down for the circular tour. As we have indicated, a number of the visitors have also made arrangements for the London part only. The visitors were due to arrive on or before Saturday last, and for that and the following day no detailed programme was provided; the official visits began on Monday afternoon, when the party assembled at the Hotel Cecil, the official headquarters for the time being, and were conveyed in motor-omnibuses to Waterloo Station; proceeding to Teddington by special train, they visited the National Physical Laboratory at Bushey, and were present at the

opening of the new Electro-Technical Laboratories by the Right Hon. R. B. Haldane, of which we give an account elsewhere in this issue.

On Monday evening the official reception and banquet given by the General Reception Committee, and members of the Institution of Electrical Engineers, to the delegates from abroad was held at the Hotel Cecil, covers being laid for 496.

Mr. John Gavey, C.B., was in the chair, and amongst the distinguished company present to do honour to the members of the kindred institutions—many of them accompanied by their ladies—were to be seen Sir J. W. Swan, Prof. G. Carey Foster, Sir William Ramsey, Sir Alexander Binnie, Lord Kelvin, Sir William White, Sir W. Crookes, Mr. C. E. Spagnoletti, Sir A. W. B. Kennedy, Sir J. C. Lamb, Prof. Perry, Col. R. E. Crompton, Prof. Silvanus Thompson, Sir Henry Mance, Major-Gen. Festing, Dr. Glazebrook, Mr. R. K. Gray, Mr. James Swinburne and others.

After the loyal toasts had been duly honoured, Mr. Gavey, speaking in French, toasted "The Visiting Delegates," to which felicitous but commendably brief replies were made by Profs. Farny and Hospitalier, Dr. Budde, Mr. S. S. Wheeler, Dr. Emil Naglo and Signor Guido Semenza on behalf of their respective countries.

Signor Semenza also unveiled and presented to the English Institution, on behalf of the Associazione Elettrotecnica Italiana, a magnificent bust of the immortal Volta, a gift for which Mr. Gavey and Prof. Thompson returned thanks in eloquent and feeling terms.

Dr. Glazebrook proposed in his happiest vein the toast of "The Ladies," to which Prof. Cormack, looking unhappy and anything but like a ladies' man, responded. Our sympathies went out to him, for it was no ordinary ordeal, and required more than ordinary courage on the part of a mere man to face the tender glances and bewitching smiles of the gentle representatives of six nations.

During dinner the string band of the Royal Engineers, under the bâton of Neville Flux, A.R.A.M., performed a selection of music which, to us, seemed singularly inappropriate. It would have been easy to have arranged the programme so as to include a selection of national melodies, several numbers from Moskowski's suite "From Foreign Parts," and other items suitable for the purpose. This, to some, may be thought mere sentiment, but we know that sentiment enters largely into the feelings of our Continental friends.

Speeches ended, the company reassembled in the reception room and spent the remainder of the evening in friendly intercourse. From beginning to end the utmost cordiality and enthusiasm prevailed, and hosts and guests alike are to be congratulated on an international "entente cordiale" not likely to be effaced during this generation.

Two motor-'bus loads of visitors, Group D, left the Hotel Cecil at 9.30 on Tuesday morning, under the able leadership of Messrs. O'Gorman, Duddell and S. Z. de Ferranti, to visit the Lot's Road power station of the London Underground Electric Railways Co. This station, though previously described in the technical journals, was new to almost all the party, and great interest was expressed in all the details, which were courteously explained by the engineers of the company.

The visitors first inspected the coal conveyer, and special interest was shown in the great height to which the coal is carried. From this point the visitors passed through the oil cooling house, and thence into the lowest floor of the main station, where the electric accumulator locomotive was being employed in the removal of ashes. Then they went up through the two tiers of Babcock & Wilcox boilers into the main station, where an excellent opportunity was afforded to visitors to inspect the various parts of the Westinghouse steam turbine units, which our readers will recall, are of the horizontal type, each rated at 5,500 KW. Some of these machines were in process of adjustment and inspection, and the method of design employed, more especially the extremely large air-gap on the generators, was the cause of some very interesting discussions between the engineers of the various companies represented.

The large space taken up by the switching apparatus and the bus-bar compartments, which is in accordance with American practice, proved another interesting item.

About 11.30 Mr. Spiers, of the Morgan Crucible Co. appeared, and invited some of the members to visit his factory across the river, where a most interesting series of experiments and commercial tests of various forms of brushes was exhibited; keen interest was taken in his latest and most ingenious pneumatic brush-holder, in which the pressure (which is in the neighbourhood of 3 lb. per sq. in.) is applied to the brush simply by air, springs being entirely discarded. The air is supplied from a small hand accumulator to a hollow stud, being tapped off for each individual brushthrough small holes into a neatly arranged air cushion.

The actual pressure is transmitted to these brushes simply by a point which leaves the brush free .to move slightly in any direction, the forward movement along the commutator being prevented by a small iron barrier rod. This arrangement appears to eliminate all vibration, and the commutation shown was very good, though the generator was turbine driven at 4,500 r.p.m., and of the old shunt-wound type with no special commutating devices. A grooved commutator was used, and the comparative wear of commutator with carbon brushes supported as above was very small when compared with that of the copper or brass type frequently used.

The visitors then returned to Lot's Road and joined the rest of the party, which proceeded to Earl's Court, where luncheon was served at the Welcome Club.

Group A visited the telegraph and telephone installations of the General Post Office and the London Wall Exchange of the National Telephone Co.; Group B went to Greenwich by electric car, and inspected the generating station of the L.C.C.; Group C was taken by motor-'bus to the Bow generating station of the Charing Cross, City and West End Electricity Supply Co., and these three groups partook of luncheon together at the Ship Hotel, Greenwich.

Group E visited the generating station of the Central London Railway Co., travelling to Shepherd's Bush by the Baker Street and Waterloo and Central London Railways. The two groups D and E were entertained to luncheon at Earl's Court Exhibition; the arrangements were entrusted to a Ladies' Committee, consisting of Mrs. Gavey, Mrs. Hopkinson, Lady Kelvin, and others, the Council being represented on the Committee by Messrs. Hammond, Hirst and O'Gorman.

Some 170 guests sat down, and the chair was taken by Mr. J. Gavey, C.B., supported by Messrs. R. Hammond, H. Hirst, S. Z. de Ferranti, Col. Crompton, and other well-known figures in the British electrical world.

The Austrian luncheon, Austrian band and the many other comforts which were afforded helped to make the gathering a most pleasant one, the success of which, as Mr. Gavey announced, was due to the efforts of Mr. H. Hirst, in whose hands the Council had placed the management.

Prior to the luncheon, some 15 motor-cars (lent by members of the Institution) under the leadership of Mr. Hammond, conveyed the ladies through the Strand to St. Paul's then through the City up to the Tower and back again *viâ* the House of Commons to Earl's Court, where the gentlemen who had visited Shepherd's Bush and Lot's Road were awaiting them.

In the afternoon a large party visited the Robertson Electric Lamp Works at Hammersmith.

In the evening most of the visitors were present at the Reception and Conversazione of the Institution of Electrical Engineers, which was held in the Natural History Museum; much interest was manifested in the admirable collection of exhibits, including our friend the Diplodocus, and the guests appeared to be well pleased with the entertainment provided.

The event of Wednesday was an excursion to Windsor Castle, followed by luncheon at the White Hart Hotel and a trip up the Thames to Maidenhead and Cookham. The journey to and from Windsor was made by special G.W.R. train, and for the river excursion to Cliveden four steamboats were engaged. Weather conditions were propitious, and a more enjoyable outing could hardly have been devised.

Yesterday those members of the party who are going on the circular tour were to leave London for Birmingham and Manchester early in the morning, by special train.

BUSINESS NOTES.

Flame Lamp.

Flame Lamps.—Messrs. G. Straus and Co., Ltd., of London, E.C., are supplying Flame lamps of British manufacture, which are claimed to burn satisfactorily in either ordinary or public service for practically the same period as ordinary open white arc lamps. The mechanism consists of two solenoids and a rocking lever, which control a train of wheels, to which the carbon holders are connected by copper cords. The solenoids are differentially wound, and feed the carbons with great regularity. A metal economiser is used in place of porcelain or fireclay, so that there is no trouble from these breaking. The lamps are strongly and substantially made, and as the covers and globes are easily removed, trimming is a simple matter. Steatite and mica insulation is used throughout, and all parts are made to gauge, and are interchangeable. The lamps are, at present, made in two sizes, namely, for 10 to 12 hours, and 16 to 18 hours; the overall length of the former is 40 in., and of the latter 50 in.

A New Typewriter Attachment.—A new and ingenious arrangement has been placed on the market by the Elliott-Fisher Co., of New York, to work in conjunction with their accounting typewriters, whereby the figures typed in the columns of any book or bill will be automatically totalled. This adding attachment can be fitted to the company's standard "billing" machines. Provided no errors in the typewriting are made, it is impossible for mistakes to occur in the addition of the figures. We have seen the machine, but are unable to give a detailed description; those of our readers interested should apply to the company at their London address, 75, Cannon Street, E.C., for further particulars.

Dick, Kerr Contracts.—The following contracts have recently been booked by Messrs. Dick, Kerr & Co., Ltd.:—

New South Wales Government.—Two 450-kw. rotary converters, similar to those supplied by the same firm under the original contract.
Bolton Corporation Tramways Committee.—One 1,600-kw. alternator.
Stoke-upon-Trent Corporation Tramways Committee.—One 250-kw. generator.
Glengarnock Iron and Steel Co., Ltd.—One 300-kw. generator.
Kilmarnock Corporation Tramways Committee.—One 275-kw. steam generator set.

Point Controllers.—Messrs. S. Dixon & Son, Ltd., have lately received an order for nine Turner's automatic point controllers for the Rochdale Corporation, also orders from the Manchester Corporation and others, both here and on the Continent. Orders for over 100 are at present in hand.

Toronto Electrical Workers on Strike.—On June 13th, writes our Toronto correspondent, some two hundred electrical workers affiliated with the local union laid down their tools because their employers refused to accede to their demands for higher wages. The men have been working on an eight hours' day, and receiving 27½ cents per hour. The strikers are asking for 35 cents per hour, and assert that workmen in the electrical trade in Toronto are paid lower wages than in any other large centre on the continent outside Montreal. In Niagara Falls and Buffalo the common rate is $3 and $3.50 per diem. Trade is very brisk at present with some large contracts in course of completion, and it is thought that the strike will not last more than a few days. Some of the large firms affected are Messrs. Bennett and Wright, the Keystone Electric Co., Keith & Fitzsimmons, and the James Morrison Co.

Condensing Plant.—The Mirrlees Watson Co. have recently secured a contract for surface condensing plant to work in connection with a 3,000-kw. Willans turbine at the City of Leeds electric lighting station. The condenser is of the vertical open-top type. It is especially designed to meet such trying conditions as are met in using condensing water from the River Aire, which contains a large amount of woolly material floating down from the mills, and which, in an ordinary way, chokes the condenser tubes. The condenser can be easily cleaned whilst the plant is in operation, and the flow of water can be reversed as desired to facilitate the cleaning. In this special case the water has only a single course of flow through the condenser. A vacuum of 28 in. is to be maintained under ordinary working conditions. The circulating water is delivered by a motor-driven centrifugal pump, and the air pump is of the Mirrlees-Edwards' three-throw type, 22 in. diameter × 15 in. stroke, driven by a three-phase motor. Messrs. Mirrlees, Watson are also to supply for the Dalzell Steel Works, Motherwell (Messrs. David Colville & Sons, Ltd.), an elevated self-draining counter-current jet condensing plant, for dealing with 80,000 lb. of steam per hour. This steam is taken direct from several large rolling mill engines, and the plant is specially designed to meet the intermittent discharge from such engines. The condenser is erected on a steel tower, and is self-draining through a barometric pipe. The air is dealt with by a Mirrlees dry slide valve air-pump, and the condensing water is delivered to the condenser and cooling tower by motor-driven centrifugal pumps.

Book Notices.—"Fire Tests with Floors"—Red book of the British Fire Prevention Committee, No. 112. London: The Committee. 2s. 6d.

"The Corrosion and Protection of Metals." By A. H. Sexton. Manchester: The Scientific Publishing Co. 5s. net.

"The Physical Review," Vol. XXII, No. 6, June, 1906. Lancaster, Pa., and London: The Macmillan Co.

"Journal of the Franklin Institute," Vol. CLXI, No. 6, June, 1906. Philadelphia: The Institute.

"Régles Normales de l'Association des Electriciens Allemands pour la Comparaison et l'Essai des Machines et Transformateurs Electriques." By De G. Dettmar. Translated by F. Loppé and A. Thonvenot. Paris: H. Dunod & E. Pinat. 2.50 fr.

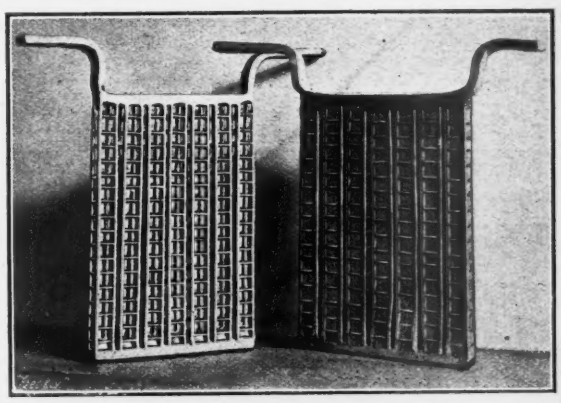
"Fortschritte der Elektrotechnik," Part 3, 1905. Berlin: Julius Springer. M. 7.

The June issue of "Progressive Advertising" contains an article on "Who's Who in the Railway Advertising Field."

"Milan International Exhibition, 1906—Catalogue of the British Section." London: The British Commission for the Exhibition, 1 and 2, Oxford Court, E.C. 50 cent'mi.

"Transactions of the American Society of Mechanical Engineers." Vol. XXVI, 1905. New York: The Society.

The Hercules Battery.—This battery will, to some extent, be familiar to our readers, as it is an improved survival of the Headland battery. Its chief feature lies in the grid employed, which is shown both pasted and unpasted in our illustration. From this it will be seen that the grid consists of a series



[Unpasted and Pasted Grids of the Hercules Battery.

of square pillars, each of which are leaden frame structures so designed as to lock the paste in position. The electrolyte circulates freely round the pillars, the whole four sides of which are active. The arrangement results in a mechanically strong plate, free from the chance of buckling, yet presenting a very large active surface, and calculated to withstand very severe usage. As a matter of fact, we understand that cells of this make have been subjected to very severe charge and discharge tests with every satisfaction, and have shown substantially increased capacities above the average. With a view to giving some idea of its capabilities, the Hercules Electrical Manufacturing Co., of Church Lane, Battersea, have submitted the following result of a series of tests recently made; the Hercules cell being tested against the best two of 18 other types of cell:—

	Sample cells.		Hercules cell.
Size of each plate	7·2 in. × 4 in.	8 in. × 4·5 in.	6·7 in. × 5·75 in.
Weight of plates	29·5 lb.	33·6 lb.	33 lb.
Average discharge in watt-hours	204	230	280
Watt-hours per lb. gross weight of complete cell	6·7	4·24	7·4
Mean percentage energy efficiency	66	70	70·9

Trade Announcements.—Mr. J. A. Rudd, M.I.E.E., is about to sever his connection with the British Insulated and Helsby Cables, Ltd., whom he represented in Scotland, first as the Telegraph Manufacturing Co., Ltd., of Helsby, from 1892 to 1902, and subsequently, after the amalgamation of that company with the British Insulated Wire Co., of Prescot, as the British Insulated and Helsby Cables, Ltd. The change dates from June 30th. On that date Mr. Rudd removes to 68, Gordon Street, where he will continue to carry on the other branches of his business as hitherto. He invites other cable-makers to send lists and terms.

The British Electrical Trade Supply and Bitumen Co., announce that the agency arrangement which they have with Messrs. Rumney & Rumney for the sale of refined Trinidad bitumen and insulating box compounds terminates on the 30th inst. Communications should be sent direct to the company at Canal Bank Trundley Road, Deptford, London, S.E.

Messrs. W. Sisson & Co., Ltd., have now removed to their new works at Elmbridge Road, Gloucester. The London agents are Messrs. Agnew & Donaldson, 25, Victoria Street, S.W. Messrs. Sisson have issued a new illustrated circular of their patent enclosed engines for electrical service.

Both in Liverpool and Newcastle increasing business has necessitated Messrs. Veritys, Ltd., removing to larger premises.

The Newcastle depôt has been removed to 26, Eldon Square, at the corner of Eldon Square and Blackett Street, where convenient premises have been found for their wholesale trade business, including a show-room for art fittings. Large stocks of accessories, cable, wire, &c., are kept. At Liverpool a removal has been made to considerably larger premises at 64, Stanley Street, and this new depôt is now fully equipped with stocks so as to be of convenience to customers in Liverpool and district. The two branches remain in the charge of the managers who have been with Messrs. Veritys for several years, viz., Mr. J. L. Miller at Newcastle, and Mr. T. C. Welding at Liverpool.

Messrs. Jay, Broll & Co., of 31, Old Queen Street, Westminster, have been appointed London managers and agents for Messrs. Wm. Truswell & Son, heating and ventilating engineers, of Newcastle, Staffs.

Messrs. E. M. Evans & Son, electric light and power engineers, 18A and 18B, Fountain Street, Manchester, announce the introduction of Mr. Joseph H. Evans as acting partner in the business. Mr. Evans has been identified with the management for a number of years, and will continue in that capacity.

The I.T.E. Electric Co., of Great Russell Street, W.C., have arranged with Mr. A. Morrison, of 100, Central Chambers, 12, Waterloo Street, Glasgow, to act as their representative for Scotland.

The Cassel Self-Regulating Water Wheels Ltd., have removed their registered office to 267, Dashwood House, New Broad Street, E.C.

Robertson Electric Lamps Fire Brigade.—For the second time within a fortnight this brigade has taken part in open competition and proved successful. Nineteen teams entered for the annual competition for the silver challenge shield presented by the City of London Corporation. The shield is a very valuable one, the cost being approximately £150, and is given to the best practical work in connection with fire drill. The contest took place at the Guildhall on Saturday in the presence of an enormous crowd of spectators, including the Lord Mayor and Sheriffs, Mr. Alexander Ritchie (chairman of the City of London Committee), Sir Robert and Lady Rogers, Second Officer Gamble of the Metropolitan Fire Brigade and Lieut.-Col. Fox, chief of the Salvage Corps. In addition to the shield, silver medals were also given by the Corporation to the Robertson team of seven men.

Underfeed Stokers.—We understand that Erith's Engineering Co., Ltd., have recently installed their grateless underfeed stokers throughout a number of large new boiler plants. These include repeat orders for Lancashire boiler equipments for H.M. Government at Woolwich Arsenal, for the London and North-Western Railway at Crewe, for Messrs. Lever Bros., Ltd., Port Sunlight, and for the Bolsover Colliery Co., Ltd., Chesterfield. For the Cargo Fleet Iron Co., Ltd., Middlesbrough, 20 stokers have been fitted to Nesdrum water-tube boilers; for the Durham Collieries Power Supply Co., 15 have been fitted to Babcock water-tube boilers; and other contracts are from Southend Electricity Works for fitting to economic boilers, and for Islington Electricity Works for Babcock boiler.

Catalogues and Lists.—The Union Electric Co., Ltd., have issued for the benefit of the users of arc lamps a card of simple instructions for their maintenance; there are some special "Don'ts" for the users of "Excello" lamps. The company issues this card either to consumers or to trade customers, and anybody can have a copy if they choose to write for it.

The A.E.G. Foreign Department, 125, Charing Cross Road, W.C.—Three new publications of their series. No. 10 fully details, with diagrams, prices, &c., their switches, wall fittings, key switches, also fuse plugs, blocks and distribution boards, cut-outs, &c. No. 11 is devoted in similar manner to particularising electricity meters for continuous, single and three-phase current; and No. 12 deals with rubber-insulated wires and cables, type QV.

Messrs. Geipel & Lange, Vulcan Works, London, S.E.—Illustrated catalogue (72 pp.) in which are shown by dimensional diagrams and half-tone blocks the "Schureman" automatic motor-controlling rheostats. Several types of self-starters are described, also pressure regulators, reversing and non-reversing switches, lift controllers, and other special lines. Prices are given.

The Linolite Co., 25, Victoria Street, S.W.—Two new illustrated circulars, one giving general information concerning this excellent system of electrical illumination, and the other stating prices.

Messrs. Thomas Parker, Ltd., Wolverhampton.—Small leaflet containing a number of illustrations of their patent "C" type dynamos and motors, and giving a few general descriptive notes regarding their design, &c. The machines are made in all sizes up to 300 B.H.P.

Messrs. Johnson & Phillips, Ltd., Charlton.—New booklet relating to their "Isola" white Anti-friction metal.

Brush Electrical Engineering Co., Ltd., London, S.E.—The *Brush Budget* for June, contains, like former editions, various illustrated articles concerning the company's manufactures. Their electric colliery plant, motors, triple-expansion engines, inter-urban cars, and 'bus bodies are referred to, and among the photographs is a view of the latest extension at the Loughborough works, which has been rendered necessary by the increased demand for steel rolling stock.

Messrs. Ernest F. Moy, Ltd., Camden Town.—Supplementary list, giving illustrated particulars and prices of tumbler switch distributing boards and porcelain bridge fuseboards.

The British Johns-Manville Co., Ltd., 81, Fenchurch Street, E.C.—Illustrated list giving information concerning, and prices of "Noark" enclosed indicating fuses and fuse devices.

The Electrical Co., Ltd., London, W.C.—A number of new leaflets and cards particularising briefly their E.C. electric fans and ventilators, tramcar watt-hour meters, time meters and switches and battery meters. A separate 16 pp. booklet gives prices and illustrations of a variety of the company's fans for A.C. and D.C.

Mr. Percy Pitman, Bosbury, Ledbury.—Several illustrated lists concerning the "Hector" water motors, also these motors driving dynamos for battery charging, and the tangential water-wheel with adjustable nozzle.

Vortex Pulley and Belting Co., London, E.C.—Illustrated price-list of "B.B." wood split pulleys.

Messrs. Carl Schleicher & Schull, Düren, Germany.—Small booklet consisting of specimens of their sectional drawing and tracing papers.

The General Electric Co., Ltd., London, E.C.—New illustrated pamphlet, just issued, giving a description, and a note of prices, of their three-phase high tension oil switches. Current and potential transformers, also relays for use therewith are shown.

Societe Gramme, Gray's Inn Road, W.C.—List "S," containing illustrated particulars of their petrol-electric generating sets and storage batteries for country house installations.

Messrs. Babcock & Wilcox, Ltd., London, E.C.—64-page booklet just issued containing a description and notes on performances of their patent mechanical chain grate stokers. Some fine half-tone photographic views appear of some of the leading boiler houses where these stokers have been installed in connection with Babcock boilers, including Lot's Road, Neasden, Park Royal, Carville, Manchester, Glasgow, and other power stations. Engineers will find a great deal of tabulated data concerning boiler tests, fuel analysis, and achievements of the stoker in the direction of smoke prevention and economical working, both as regards coal consumption and cost of up-keep. The lowest coal costs are claimed for Hackney, in London, and Carville, in the provinces, at both of which stations the stokers are installed.

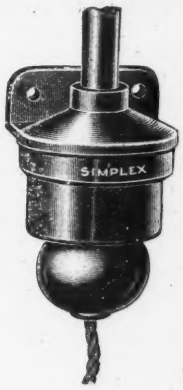
Hawaii.—The British Consul at Honolulu reports that additions to tramcar lines on the city and suburban system last year amounted to a little over 1,100 yards. Express cars for delivery of parcels have been added, as well as an oil tank car with a capacity of 63 barrels, for the company's own use and for delivery to customers. The town of Honolulu is very completely lighted by electricity, but during the past year gasworks have been started.

Dissolutions and Liquidations.—Simplex Steel Conduit Co., Ltd.—This company is now winding up voluntarily, with Mr. A. J. West, Waterloo Street, Birmingham, as liquidator. This is, of course, the old company, the new one being Simplex Conduits, Ltd.

Messrs. Heaton & Smith, Ltd.—A meeting is to be held at 22, Booth Street, Manchester, on July 30th, to hear an account of the winding up from the liquidator, Mr. J. P. Garnett.

Mr. S. J. A. Mills, 51, Suddell Road, Darwen, notifies that on May 15th he relinquished partnership with Mr. Joseph McDermott, trading as the Lancashire Electrical Engineering Co., Ltd. Mr. Mills will continue business in his own name as mechanical and electrical engineer.

New Testing Brake.—Messrs. Johnson & Phillips, Ltd., Charlton, have secured the manufacturing rights for the Collins' testing brake. The brake was designed by Mr. E. J. Collins, assistant in the Physical Department at the Royal Naval College, Greenwich, for taking the B.H.P. of engines and motors. It was designed with a view to rigidity and simplicity in working, only one attendant being required to operate it, at the same time taking the speed of the machine under test. It consists of a strip of suitable form and material, usually rope, embracing the pulley on the machine under test. The tension on the rope is determined by a spring balance attached to each end of the brake strap; the tension of each spring being so adapted that it may be read by an index and graduated scale. The pressure on the pulley of the machine under test is adjusted by means of a screw operated by a handwheel at the side of the brake strap which is subjected to the greater tension, so that the tension may be adjusted quickly. The frame of the apparatus is built up of iron, and may be adapted to motors of various sizes and suitable for bolting on to the frame or foundation of the motor. Should the foundation bolts of the motor not be sufficiently long, an adapting device can be supplied with the brake. The frame is also arranged for sliding in the direction of the axis of the motor so that the spring balances are brought into the central plane of the pulley under test. The frame is also arranged to allow for adjustment to suit various diameters of pulleys and widths of motor bases. The above is the arrangement for testing motors up to about 20 H.P. For larger sizes the frame is arranged for bolting on to the testing plate, the balances being fixed in an horizontal plane. We understand that should the motor under test come to a standstill, the two balances will adjust themselves to equal tension, avoiding any accident to the springs.



"SIMPLEX" WALL PLUG.

Simplex Watertight Wall Plug.—The accompanying figure shows an iron-clad type of wall plug of novel design, and combining great mechanical strength with high insulation. It is being supplied by SIMPLEX CONDUITS, LTD. The vertical pattern is arranged for fixing upright on the wall, and is specially adapted for workshop or outside use. The plugs are manufactured in both the two-pin or concentric types, and in the latter design a locking device is employed. The plugs are easily wired and unbreakable, all the parts being enclosed in a cast-iron case. A horizontal pattern is listed, which has three lugs for fixing, and is made for ¾ in. screwed conduit.

Electric Cooking.—The *Tyneside Electrical Pioneer* for June contains the first of a series of articles on "Electrical Cooking," by Miss L. Carter, first-class diplomee of the Northern Counties School of Cookery, Newcastle-upon-Tyne, who gave such excellent demonstrations at the recent Newcastle electrical exhibition. Definite recipes for cooking electrically are being published, some tasty breakfast dishes coming in for first treatment.

Park Royal Power Station.—We are asked to state that the large oil separators mentioned in our last week's article on this power station, were manufactured by the WORTHINGTON PUMP CO., LTD. Eight of them were supplied, and both separators and valveless pump were principally prepared to the specification of Messrs Kennedy & Jenkins.

LIGHTING and POWER NOTES.

Canada. — WINNIPEG.—Our Canadian correspondent writes that, as a result of investigation, ample water-power has been found available for the generation of electrical energy to supply the city. On the 28th inst. the City Council decided to take a poll of the citizens as to whether the municipality should undertake a scheme. It is proposed to create debentures to the value of $3,250,000, and extinguish the debt in the course of 40 years. There are other propositions before the Council for the erection of an undertaking, one promoter being Mr. J. D. McArthur. He proposes to put down a plant at Lac du Bonnet, 60 miles north-east of the city, in return for a franchise and the right to supply the municipality. A Chicago firm has also made a preliminary offer to the Council in the matter. An important factor in the situation is the Winnipeg Electric Street Railway Co., which has recently completed the erection of plant, which it has taken 3½ years to accomplish, at a cost of over $3,000,000. The company can develop 30,000 H.P., and, as its own requirements are something in the neighbourhood of 10,000 H.P., it looks to have its share in supplying power to the Winnipeg factories in the future. The water-power in the neighbourhood of Winnipeg is practically inexhaustible, and an expert has stated that the Winnipeg River alone is capable of furnishing nearly a million horse-power.

China.—The British Consul at Chinkiang, in a recent report, states that in the latter part of 1905 a Chinese syndicate set up a plant for lighting the town by electricity. It has not at present proved an unqualified success, because the management of the syndicate does not impress the public with its reliability. The authorities of the British Concession have imposed certain conditions—calculated to improve the existing arrangements of the syndicate—and as a necessary preliminary to the introduction of electrical energy into the concession. The matter is under negotiation. The plant erected by the syndicate has German dynames and Chinese boilers.

Clevedon.—The *London Gazette* contains notification of the revocation by the B. of T. as from June 16th of the Clevedon, Portishead and Long Ashton Electric Lighting Order, 1904.

Continental Notes.—ITALY.—The municipal authority of Schio has decided to improve the public lighting of the town, and to meet that end has granted a concession for 10 years to Messrs. Fratelli, Mauri, of Casamicciola, the firm having the option to supply energy for power purposes also. A new water-power installation of 20,000 H.P. is to be carried out on the Cellina. It is stated that the energy generated will be supplied to Trieste.

A meeting has recently been held at Sinigallia, at which it was decided to form a company for the erection of a barrage on the Sentino and the Frasassi to develop 4,500 H.P. The energy obtained is to be used for electric traction on the Sinigallia-Acevia-Lassoferrata railway and for industrial purposes.

La Società Elettrica del Pellino is the name of a new company which has just been formed in Milan with a capital of £16,000 to light the town of Borgomanero by electricity.

La Società Elettrica di Borno has secured an electric power concession from the authorities of the Province of Brescia. A water-power plant is to be erected on the River San Fiorano.

AUSTRIA.—The Aktiengesellschaft Gebruder Böhler, of Oberaich, proposes to develop the water power of the River Mur to the extent of 4,000 H.P. for use in the Kapfenberg Steel Works of the company.

ROUMANIA.—The municipal authorities of Piatra-Niamtz are about to invite tenders for the electric lighting of the town.

PARIS.—No municipal council has ever been apparently more worried with its future policy regarding electric supply than is the City Council of Paris at the present moment. In April, 1907, and December, 1908, expire the concessions now held by various "sectors." Mr. Felix Roussel has now presented his report to the Council, in which he makes a complete and technical study of the question in view of the possibility of one of the four following solutions to the problem:—(1) Direct control; (2) interested control; (3) bulk supply; (4) concession. Mr. Roussel exposes the advantages of each without, however, pronouncing for any. He appeals to the councillors to come to a decision. Each of the solutions proposed is hedged around with minor difficulties. The Council, as a whole, in view of the unsettled state of municipal financial enterprises, hesitates to declare for a direct control of the electrical enterprises. The Council, however, considers the continuance of the present concessions, with their expensive administration, a thing not to be thought of. It desires, as expressed in recent debates, to remain master of the tariff applied for electrical energy. It is endeavouring to do this, and at the same time obtain advantageous terms with the future concession holder. If the Council deliberates too long, a hasty treaty with a temporary "concessionaire" will be the only solution of the problem.

The conclusions advanced in the report of Mr. Felix Roussel, however, were arrived at, and the report was printed, before the passage of the recent law through the French Senate, which deals with electric power supply in Paris, among other matters. This law was passed on June 12th, and practically ties the hands of the municipality in respect to any profit-making schemes with the electrical industry which it may have in mind.

The *Journal Officiel* of June 17th contains the text of the law adopted by the Senate and the Chamber of Deputies and promulgated by the President of the Republic, regulating the establishment and working of electric supply enterprises in France. The *Journal* may be seen on application at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-Street, E.C.

Cuba.—The Camaguay Electric Co., Ltd., has been registered at Ottawa, Canada, with a capital of $350,000, with the special object of carrying on an electric light, heat and power business in Cuba. The directors are Messrs. R. V. Sinclair, A. F. May, A. McFarlane, W. H. Middleton and C. F. Moffatt, all Ottawa capitalists. The head office of the company is at Halifax, Nova Scotia.

Dundee. — Messrs. Cox Bros. a short time ago put down an electrical installation in their Camperdown works, and as electric driving has proved very satisfactory, large extensions are in contemplation.

East Ham.—The L.G.B. has notified that it will sanction the borrowing of £14,192 of the loan of £18,750 applied for. The President of the L.G.B. is to be asked to receive a deputation from the T.C. as to the balance not sanctioned.

Exeter.—There are about 1,200 public lamps in Exeter in the 40 odd miles of street outside the area lighted by arc lamps. Each lamp is required, under the contract with the Gas Co., to supply a light equal to 14 C.P., omitting certain special lamps of higher illuminating power, but the lighting of these lamps is not satisfactory. The bill with the gas company is over £4,000 a year. The contract terminates at Michaelmas next, and the proposals of the Lighting Committee and the Electricity Committee jointly are to divide these areas into three sections, to increase the C.P. in each section, and to put up in special places lamps of increased brilliancy.

Having regard to the fact that the electricity undertaking belongs to the city, and the margin of difference between the rival tenderers in the three sections is small, the Committees have resolved to recommend that the order for lighting these areas be placed in the hands of the E.L. Committee, except Section 3, which shall be lighted by incandescent gas, these conditions to obtain for a period of five years or more, the Council to then determine which lighting is best for the whole city. The subject is to be fully considered at a meeting of the City Council on the 2nd prox.

London.—L.C.C.—The Council on Tuesday had under consideration a report by the Finance Committee, on an application from the Islington B.C. for sanction to borrow £3,834 for arc lamps and columns, and £13,322 for the laying of mains. Some of the streets proposed to be lighted by electricity are at present lighted by incandescent gas installed by the Gas Light and Coke Co. as recently as 1903, and a loan in respect of which was sanctioned by the County Council in 1905. It was also intended to lay mains for general supply, although the primary object was street lighting. The total cost of the scheme amounted to £21,011, of which the Council had already sanctioned the sum of £3,812. The Committee proceeded to state:—

"The annual cost of maintaining the lamps which will be superseded, including the cost of the gas, has been, according to a report of the borough treasurer, £2,376, whilst the cost of maintaining the arc lamps, irrespective of the cost of electric current, is estimated by him at £1,520, and the amount required to meet the charges for interest on and redemption of the loan of £5,023 for lamps and columns is £351, making a total of £1,871. It would appear from these figures that the Borough Council will effect an

annual saving of £505 a year as a result of installing the electric light. It will, however, be observed that in making this calculation, the new lighting scheme has not been charged with any sum in respect of the electricity, as the Borough Council proposes to charge the street lighting account with the same amount as before, although supplying a much larger amount of energy. The electric lighting accounts for 1905-6 show a net surplus of £7,640, but the Borough Council's estimate shows that if the new street lighting scheme had been in operation, the surplus would have been £5,620, showing that the new scheme will involve a charge on the undertaking of some £2,000. The cost of lighting these streets by electricity would consequently be about £1,500 in excess of the cost of lighting them by gas, although the street lighting account of the Borough Council would show the scheme to be less costly than the present system of lighting by £505. There is, moreover, a sum stated to be £730 6s. 8d. still owing to the Gas Light and Coke Co. for installing the gas lighting system which it is proposed should be superseded. It has been represented to us that this extension will prove of benefit in the future. This may be so if a large number of private consumers should be obtained on the routes where the new mains may be laid, but upon this point the Borough Council has not supplied us with any particulars. We have felt great hesitation in advising the Council to sanction the borrowing of this large amount, having regard to the general position of the undertaking and the fact that we do not altogether share the Borough Council's views as to the financial advantages of this extension of their undertaking. At the same time we do not think that this is a case in which the Council should refuse its sanction to the borrowing of the money. The Borough Council should, before borrowing money for the installation of the new system of lighting, be required to repay to the Gas Light and Coke Co. the amount due to it." In these circumstances the Committee recommended the L.C.C. to sanction the loan, but the order not to be issued until evidence was produced showing that the Borough Council had repaid the sum owing to the Gas Light and Coke Co.

Mr. Buxton, who opened what proved to be a long discussion, moved that the recommendation should be referred back to the Finance Committee for reconsideration, having regard to the financial position revealed in the report.

Sir R. M. Beachcroft, who seconded the amendment, stated that the period of 42 years for repayment was fixed 10 years ago. In his opinion it would be advisable to reduce the period by from 10 to 15 years, so as to protect the ratepayers of the future from being charged for works undertaken by the ratepayers of to-day.

Mr. A. M. Torrance, an Islington member, supported the amendment. He declared that in the circumstances Islington was not justified in coming forward for a loan on the subject.

After further discussion, the amendment was carried by 35 votes to 31 on a show of hands; but, on a division, the amendment was defeated by 56 votes to 39, and the recommendation of the Committee was then agreed to.

The Committee further stated that no reserve or renewals fund had yet been established in connection with the Islington electric lighting undertaking, and from a report recently made by the borough treasurer, it did not appear to be the present intention to form such a fund. The total amount borrowed by the B.C. down to March 31st, 1905, was £406,437, and £373,262 of that sum was then outstanding. The money was nearly all borrowed for a period of 42 years, on condition that all renewals and replacements should be met out of a sinking fund or from maintenance account. It appeared to the Finance Committee that the matter was of much importance, and on their recommendation the Council decided to ask the Islington Council what action was proposed to be taken, and to urge upon the borough the advisability of establishing a reserve fund.

Hammersmith.—Application is to be made by the B.C. to the L.C.C. for a loan of £19,343 in respect of the following: Mains and sub-stations, £7,138; service lines, £2,102; boiler house foundations, wiring, &c., £645; pumps, feed-water heater, forced-draught apparatus, &c., £1,726; works and machinery included in the £40,000 estimate for extension scheme, £7,730.

Stepney.—The E.L. Committee has been instructed to consider and report as to whether the engagement of the consulting electrical engineer can now be advantageously terminated.

Limerick.—The Corporation recently decided to apply for a loan of £5,000 to cover the cost of further plant extensions.

Londonderry.—The following revised scale of charges has been decided upon by the Corporation:—Lighting, 6d. and 1½d. maximum demand system, or 4½d. per unit, flat rate; heating, 1d. per unit flat rate; motive power, 2d. for first 500 units per quarter, 1½d. for balance; 1d. time switch system. Meter and service rents, 5s. per annum.

Manchester.—Messrs. Halls, Ltd., have decided to adopt electric power in their extensive mineral water and bottling works at Walkden.

The Earl of Ellesmere's mansion, at Worsley, is to be furnished with an electric lighting installation.

Motherwell.—The following new scale of charges for energy has been fixed by the T.C.:—Lighting, 3d. per unit; power and heating, 1d. per unit for the first 40,000 per quarter; ¾d. per unit for any quantity over 40,000 units per quarter. Any consumer using not less than 15,000 units per quarter for power is to receive energy for lighting purposes at the following rates, provided the energy used for lighting purposes shall not in any quarter exceed 20 per cent. of the total amount supplied: 1½d. for the first 5,000 units, 1¼d. for the second 5,000,-1d. for the next 15,000, and ¾d. for any further quantity used per quarter.

Paignton.—The B. of T. has revoked the E.L. order, 1902.

South Africa.—East London.—At a meeting of the T.C. on May 29th, the joint report of the electrical engineers, Messrs. John Roberts and W. Long, borough and city electrical engineers, of Durban and Cape Town, called in to advise on the electricity department, was submitted, and it was decided to adopt the main principles of that report.

Their report corroborates the recent report submitted by the town electrical engineer, Mr. J. Mordey Lambe, and clearly shows that the most satisfactory way out of the present condition is to build a new power station, add new plant in place of some of the present plant and change the distribution of private supply from the single-phase, 100-volt, two-wire, to a two-phase, 220-440 volt, three-wire system; by which means a saving of about £10,000 per year may be effected.

The deficit last year amounted to no less than £11,620, there being a loss of £1,398 on the private supply, a profit of £706 on the street lighting, and a loss of £10,928 on the tramways. The losses generally are due to high cost of generation, but the tramway losses are stated to be due to the excessive cost of repairs to cars and high cost of traffic management, also to the low speed at which the cars are operated.

The amount of new capital expenditure recommended is as follows:—Power station, £35,000; H.T. cables, &c., £7,500; doubling and improving tramway tracks, £5,000; total, £47,500. The financial result of such expenditure at the end of the first year's working is estimated as being:—Private lighting, £6,604 profit; tramways, £1,228 loss; street lighting, £606 profit.

The amount spent during the six years of operation is shown as £122,902, of which it seems £20,058 has been written off for depreciation. The total cost of generation in the past year works out at £20,583, or 4·1d. per unit, and with capital charges the total cost is £24,287, or 4·8d. per unit, while the cost of energy delivered at the consumers' terminals amounted to 10d. per unit. Under the new scheme the total cost for generation is shown as £10,000, or 1·7d. per unit, and including capital charges the total cost is £14,908, or 2·6d. per unit, while the cost at consumers' terminals is only 5½d. per unit.

The site proposed for the new station is on land adjoining the present works, and it is suggested to erect a steel framework covered with iron, and a steel smoke stack. The new machinery suggested is coal conveying plant, mechanical stokers, new superheaters (for the present B. & W. boilers), economisers, water purifying plant, condenser, switchboard, two 500-KW. lighting sets, and a combined 200-KW. tramway and lighting generator coupled to the same engine, to take the load for both systems during the greater part of the 24 hours. The present four B. & W. and one Davey-Paxman boilers, and the 200-KW. Belliss tramway generator and 200-KW. Belliss alternator would be removed into the new power station; and it will be necessary to abandon the two 180-KW. Lowrie-Hall alternators and Belliss engines, two exciters and three 80-KW. Belliss tramway generators.

The present number of sub-stations is 32, which can easily be reduced to six with the suggested improvements, which will necessitate 10 miles of H.T. concentric cable. Considerable work will be necessary with the overhead mains, but this could be gradually carried out.

The tramways system has a D.C. 500-550-volt supply, and is not open to any improvement; the mains and overhead equipment, while capable of being brought up to a better condition, do not call for any immediate attention. The speed of the cars should be increased 50 per cent., but to do this it is necessary to thoroughly overhaul the whole of the track, which is in a very bad state, the joints having sunk, and in many cases the points and crossings will have to be completely renewed. Useless curves have been introduced at places, and to get over that difficulty it is suggested to double that portion of the track from the car-shed to the junction of Upper Oxford Street and Southerwood routes. The repairs to rolling stock work out at nearly £530 for each of the nine cars, but with the increased speed six cars would meet the demand, and by reducing the staff, which is at present largely in excess, the cars should work out at about £300 each for repairs.

In conclusion, it is suggested that the possibility of taking energy in bulk from the new power station of the East London Harbour Board is worthy of consideration.

South America.—The electric light supply was inaugurated at Chivilcoy on May 24th last, the concessionaires being Messrs. Trant and Soldani.

A recent issue of the Diario Oficial (Rio de Janeiro) contains the terms of a decree authorising the establishment of the Bahia Gas and Electric Co. with powers to carry on enterprises in Brazil. The company was founded at Portland (Maine) at the end of 1905 for the purpose of supplying the town of Bahia and other Brazilian towns with light, heat, and power by gas or electricity, and also to erect bridges and other engineering works.

West Ham.—In a report issued on Monday the electrical engineer stated that in addition to the 1,500 H.P. in motors connected to the Corporation mains on March 31st last, 500 H.P. had been ordered by new and old consumers, including the complete equipment of some of the most important factories in the borough. The estimated annual consumption of the additional motors was 1¼ million units per annum. Negotiations were pending for a very much larger amount. The increase in the lighting business had proceeded at a very satisfactory rate since March 31st. Nearly as many consumers had been connected since then as were connected during the whole of the past financial year.

(Continued on page 1047.)

Supplement to the "ELECTRICAL REVIEW," June 29th, 1906.

"ELECTRICAL REVIEW" LIST OF ELECTR

	Locality.	Lines Owned by	Year of opening.	Tramways Manager.	Tramways Electrical Engineer.	Miles of Route.	Gauge.	Weight of Rails per yard, lb.	Motor Cars.	Power Station. Total Capacity in KW.	Power Station. Max. load in KW.	Power Station. Battery max. discharge.	Capital Outlay on Tramway and Rolling Stock.	Capital Outlay on Power Station.	Annual Electric Car Mileage.	Passengers Carried per Annum.	
1	ABERDEEN	Corporation	1899	R. Stuart Pilcher, Gen. Man.	J. A. Bell	14.1	4ft. 8½in.	98	69 d.d.	2,766	400 ave.	90 KW	£331,434	*	1,617,525	17,142,896	*Lg. & tr. station
2	AIRDRIE & COATBRIDGE	Airdrie & Coatbridge Tramways Co.	1904	A. Delves		3.63	4ft. 7½in.	94	20 d.d.				£61,441		267,942 (1905)	2,977,936 (1905)	
3	ASHTON-UNDER-LYNE	Corporation	1902	J. W. Dugdale	N. Appelbee	6	4ft. 8½in.	96	6 d.d., 6 comb.	1,250	624		£101,451		353,748	4,116,012	*Lg. & tr. station
4	AYR	Corporation	1901	W. Grant	W. Grant	8	4ft. 8½in.	96	18 d.d.	1,175*		100 KW.	£80,000	£83,000*	365,646	3,578,650	*Lg. & tr. station
5	BARKING	Urban District Council	1903			1¼	4ft. 8½in.	80	7 d.d.	450	130		£50,000†	*			*Lg. & tr. station
6	BARNSLEY	Barnsley & Dist. Elec. Traction Co.	1902	W. H. Moorhouse		3.06	4ft. 8½in.	94	12				£65,381	*	204,982		*Energy purchase
7	BARROW-IN-FURNESS	British Electric Traction Co.	1904	W. F. Bladon		5.37	4ft. 0in.	94	9 d.d. 7 s.d. (2 demi-cars reg.)	*					331,795	3,008,511	*Energy purcha Barrow-in-Furn
8	BATH	Bath Electric Tramways	1904	R. D. McCarter (Eng. & Man.)	W. E. Hardy, Resident	14¾	4ft. 8½in.	95	34 d.d., 6 comb.	675					967,637	6,746,363	
9	BATLEY	British Electric Traction Co.	1903	E. A. Paris, Man. Director	R. C. Goldston	13½	4ft. 8½in.	104	50 d.d. 8 s.d.	850	350	90 KW.		£36,068			*Leased to York Elec. Tramways
10	BELFAST	Corporation	1905	Andrew Nance	Victor A. H. McCowen	36.61	4ft. 9in.	105	220 d.d.	4,200			£952,790†	£77,486	5,169,306	30,133,027	*Lg. & tr. stn. £412.734 purcha
11	BEXLEY	Urban District Council	1903	C. Mittelhausen	C. Mittelhausen	5¼	4ft. 8½in.	90	16 d.d.	300 (tr.)	198	137 KW.	£71,267	£21,000	258,319	1,677,637	*Lg. & tr. station
12	BIRKENHEAD	Corporation	1901	Wm. Wyld	Wm. Bates	13½	4ft. 8½in.	100	46 d.d., 14 s.d.	1,475	1,343	240 KW.	£297,670	£53,141	1,319,079	11,052,114	
13	BIRMINGHAM	City of Birmingham Tramways Co.	1901	R. W. Cramp (Traffic)	G. Conaty (Man. Eng.)	14½	3ft. 6in.	90 & 97	97 d.d. s.t., 3 bo. 6 toastrack	1,098†			£617,078 inc. stns.		2,312,084	19,011,789	*Four miles lease †Two stations
14	BIRMINGHAM	Birmingham & Midland Tramways	1905	R. W. Cramp (Traffic)	G. Conaty (Man. Eng.)	12½	3ft. 6in.		51 d.d. (inc. 26 regen.), 8 s.d.	2,400							
15	BLACKBURN	Corporation	1899	J. H. Cowell, Gen Man.		23½	4ft. 0in.	92	48 d.d.	4,518*			£320,563	*	974,031	9,289,035	*Lg. & tr. station
16	BLACKPOOL	Corporation	1885	J. Lancaster (Man.) H. S. May (Eng.)	Charles Furness	11⅞	4ft. 8½in.	95	61 d.d.	1,150*	699	1,680 A.H.	£281,364	£188,155*	909,746	7,362,132	*Lg. & tr. station
17	BLACKPOOL & FLEETWOOD	B. & F. Tramroad Company	1898	J. Cameron	Angus Cameron	8	4ft. 8½in.	98, 83, 56	31 s.d.	600	480	380 KW.	£198,127		579,364	2,325,677	
18	BLACKPOOL ST. ANNES & LYTHAM	B., St. A., & L. Tramways Co.	1903	Malcolm Guthrie, Man. Dir.		7½	4ft. 8½in.	90	20 closed, 20 open d.d.						450,000	2,500,000	Figures approxim
19	BOLTON	Corporation	1900	Arthur A. Day	Arthur A. Day	26	4ft. 8½in.	96	86 d.d.	5,200*	1,600 tr. only		£462,780	£269,818*	2,235,180	21,390,116	*Lg. & tr. station
20	BOOTLE	Corporation	1900	T. D. Clothier	T. D. Clothier	3⅞	4ft. 8½in.	90	*	2,050†		500 A.H.	£75,616	£17,227	*		*Running leased t & tr. station
21	BOURNEMOUTH POOLE & CHRISTCHURCH	Bournemouth Corporation	1902	F. W. Lacey (Eng.) C. Barber (Man.)	J. Bulfin H.G.Andrews, Asst.	21½	3ft. 6in.	90, 100, 105	70 d.d., 1 saloon	1,200	1,000		£470,000 ex extens.	£75,000	1,121,623 (1905)	10,058,288 (1905)	1.35 m. dble. trac Poole and Christ
22	BRADFORD	Corporation	1898	C. J. Spencer	A. S. Blackman	53.87	4ft. 0in.	102	238 d.d., 1 s.d.						5,034,154	45,331,288	*Lg. & tr. station;
23	BRIGHTON	Corporation	1901	W. Marsh	W. Marsh	6¾	3ft. 6in.	101	50 d.d.	780	913	550 KW.	£242,811	*	1,152,828	11,321,227	*Lg. & tr. station
24	BRIGHTON	Volk's Electric Railway (Magnus Volk, Ltd.)	1883	M. H. Volk	M. H. Volk	1¾	2ft. 8½in.	35	8	60	40†	36 KW.	£10,000		80,000	720,000	*Pioneer of electri †Power from Cor
25	BRICHTON AND ROTTINCDEAN	B. & R. Seashore Elec. Tramroad Co.	1896	M. Volk	M. Volk												Not running. Lin
26	BRISTOL	Bristol Tramways & Carriage Co.	1895	Chas. Challenger	Sir J. C. Robinson	28½	4ft. 8½in.	92½	234 d.d.	2,150			£1,314,036		6,127,135	45,294,177	3ft. 6in. gauge
27	BURNLEY	Corporation	1902	H. Mozley	R. Birkett	7½	4ft. 0in.	102	24	1,180*		190 KW.	£168,600	*			*Lg. & tr. station
28	BURTON AND ASHBY	Midland Railway Co.	1905	James Toulmin	James Toulmin	13,¼†	3ft. 6in.	90	13 d.d.	330		440					*Line under cons miles belonging t
29	BURTON-ON-TRENT	Corporation	1903	P. J. Pringle	P. J. Pringle	5¼	3ft. 6in.	90	20 d.d.	400 (tr.)	250		£86,500	£71,679*	454,082	3,878,269	*Lg. & tr. station
30	BURY (LANCS.)	Corporation	1903	William Clough	S. J. Watson	10½	4ft. 8½in.	102¾	34 d.d.	1,250*	715		£215,000	£77,553*	495,079	3,916,590	*Lg. & tr. station
31	CAMBORNE, REDRUTH AND ILLOCAN	Urban Electric Supply Co., Ltd., Camborne & Redruth tr'mw'ys	1902	F. S. Hanning	F. S. Hanning	4½	3ft. 6in.	90	6 d.d., 2 s.d.*	480	250	200* KW.	£45,690	£42,082†	147,706	1,079,841	*2 Electric locos. & tin ore daily.
32	CARDIFF	Corporation	1902	Arthur Ellis	Arthur Ellis	32.62	4ft. 8½in.	100	100 d.d. 14 s.d. 16 comb.	5,400*	3,260*	150 KW.	£747,308 inclusive		2,624,840	24,127,641	Lg. dept. takes bulk at ½d. p.u
33	CARLISLE	City of C. Electric Tramways Co.	1900	G. Cook	J. B. Wilson	7	3ft. 6in.	87	12 d.d. 3 s.d.				£101,183		359,756	2,935,002	*Inch *Energy purchased
34	CHATHAM	C. & District Light Rys. Co.	1902	W. Jensen	W. Jensen	9½	3ft. 6in.	92½ & 115	40 d.d.	675	686		£161,937	£59,705 inc. car shed	862,555	7,378,893	
35	CHELTENHAM & DISTRICT	C. & District Light Ry. Co.	1901	H. J. McCormick	H. J. McCormick	10½	3ft. 6in.	83	18 d.d., 2 s.d.	330*	360 approx.	150 KW.*	£186,000 autbd.		461,031	2,987,858	*Energy obtained poration, lg. & tr.
36	CHESTER	Corporation	1903	J. Gardner	S. E. Britton	2⅜	3ft. 6in.	92	12 d.d.	1,250*	891	235 KW.			270,210.5	2,176,228	*Lg. &tr. station
37	CHESTERFIELD	Corporation	1904	R. L. Acland	R. L. Acland	3½	4ft. 8½in.	96	12 d.d.	1,000* lg. & tr.	200		£60,000	£7,000†	269,000	2,183,480	*Lg. & tr. station.
38	CLONTARF	C. & Hill of Howth Tramroad Co.	1900	C. W. Gordon	P. S. Sheardown	5½	5ft. 3in.	60, 83, 95	12				£72,500		152,000	524,000	*Energy supplied by ways Co.
39	COLCHESTER	Corporation	1904	R. C. Bullough	A. R. Sillar	7½	3ft. 6in.	95	16 d.d.				£67,000		325,000	2,500,000	*Lg. & tr. station
40	CORK	Cork Electric Tramways & Lighting Co.	1898	H. G. Whiting	H. H. Nalder	9.89	2ft. 11½in.	83	35 d.d.	1,700*	400		£173,612		900,446	5,979,882	*Lg. & tr. station
41	COVENTRY	Coventry Electric Tramways Co.	1895, '98, 1905	T. R. Whitehead	I. E. Winslow (Cons.)	13½	3ft. 6in.	81, 84 65	30 d.d.	400					675,374	3,958,950	65 lb. rails Falk weld welded
42	CROYDON	Corporation	1901	T. B. Goodyer	H. B. Harris	10¾	4ft. 8½in.	95	60 d.d.	1,950	650		£232,127		1,644,327 (1905)	14,732,446 (1905)	* Lg. and tr. station
43	DARLINGTON	Corporation	1904	J. R. P. Lunn	J. R. P. Lunn	4⅞	3ft. 6in.	90	16 s.d.				£75,000		375,755	3,285,150	*Energy purchased
44	DARWEN	Corporation	1900	R.W. Smith-Saville (Gen. Man. & Eng.	R. W. S.-Saville C. Garnett	4½	4ft. 0in.	95½	14 d.d., 1 s.d.	900*	300 tr. only	92 KW. for 2 hrs.	£85,000†		240,000	2,400,000	*Lg. & tr. station conversion £52,32
45	DERBY	Corporation	1904	F. Harding	T. P. Wilmshurst	8¾	4ft. 0in.	95	35 d.d., 4 s.d.	800*	410	190 KW.*	£136,573	£12,000 (tr. only)	766,183	7,658,537	* Lg. and tr. station
46	DEVONPORT AND DISTRICT	Devonport & Dist. Tramways Co.	1901	A. V. Mason	A. V. Mason	8.85	3ft. 6in.	92	25 d.d.	1,860*	550*	460 KW.	£162,045		564,990	4,974,319	4½ miles leased by Corp. lg. & tr. stat
47	DONCASTER	Corporation	1902	E. S. Rayner	E. S. Rayner	10	4ft. 8½in.	100	25 d.d.	660*	440		£59,077	*	436,603	2,443,998	*Lg. & tr. station
48	DOVER	Corporation	1897	E. Cardon	H. E. Stilgoe (Boro' Eng.)	4¾	3ft. 6in.	87	21 d.d.	200*		280 KW. hours	£41,850	*	303,153 (1905-6)	2,885,918 by the Corpn.; lg	* Lg. & tr. station.
49	DUBLIN	Dublin United Tramways Co.	1896	C. W. Gordon	P. S. Sheardown	48.5	5ft. 3in.	92	291 d.d., 3 s.d.	3,300	2,150		£1,900,000 inclusive		990,298	49,745,325	D.C. to line at 500v. stations
50	DUBLIN AND LUCAN	D. & L. Electric Railway Co.	1900	H. Harrison	H. Harrison	6¾	3ft. 6in.	50	5 d.d., 18 wgs., 1 loco.	240	200		£69,201*		112,704	396,032	* Including conversio
51	DUDLEY, STOURBRIDGE AND DISTRICT	D., S. & Dist. Elec. Traction Co.	1899	R. W. Cramp (Traffic)	G. Conaty (Man. & Eng.)	21¾	3ft. 6in.	90	24 d.d. 35 s.d.	700		325 KW.	£372,020			8,370,791	Power supplied by D borough
52	DUNDEE	Corporation	1900	P. Fisher (Gen. Man.)	H. Richardson	12¾	4ft. 8½in.	92, 95	48 d.d., 6 comb.	1,283*			£266,884†		933,006 (1905)	11,641,525 (1905)	* Lg. and tr. station. Sunday running no
53	EAST HAM	Corporation	1901	W. C. Ullmann	W. C. Ullmann	6.8	4ft. 8½in.	90	40 d.d.	1,925* tr. 450	1,050*		£152,277 (1905)	£117,286* (1905)	981,812	13,689,658 (1905)	* Lg. and tr. station
54	EXETER	Corporation	1905	H. C. Bartlett	H. D. Munro	4½	3ft. 6in.		14 d.d.				£55,000	£9,000*			*Tramways proportio
55	FARNWORTH	Urban District Council	1901	J. D. Pember	J. D. Pember	4¼	4ft. 8½in.	98	13 d.d.	610*	160 tr. only		£43,686 & £25,000†		242,524	1,532,293	*Lg. and tr. station. leased to Farnwort
56	FELIXSTOWE PIER	Coast Development Corporation	1905			½	3ft. 6in.	36	2 m.-cars, 1 trailer								Pier Electric Railw by Felixstowe Corp
57	GATESHEAD, FELLINC AND WHICKHAM	Gateshead & Dist. Tramways Co.	1901	W. Morrison		11½	4ft. 8½in.	90	25 d.d. 15 s.d., 10 comb.						1,266,325	11,285,769	
58	GIANT'S CAUSEWAY & PORTRUSH	G. C. & P. Electric Tramway Co.	1883	D. Fall	W. A. Traill	8	3ft. 0in.	43	3 s.d., 19 tr.	100	90		£55,472		85,947	128,546	This was the first El U. K.
59	GLASGOW	Corporation	1898	J. Dalrymple	J. Ferguson	65½	4ft. 7¾in.	100	660 d.d. 21 s.d.	11,200	7,500		£1,617,368	£956,892	14,008,750	117,179,547	6,500 v. 3-ph. to stations
60	GLOSSOP	Urban Electric Supply Co.	1903	C. E. Knowles	C. E. Knowles	4½	4ft. 8½in.	90	7 d.d., 1 s.d.	225	251	600 A.H.	£54,163	£48,037*	175,315	1,373,487	* Including mains an
61	GLOUCESTER	Corporation	1904	Leonard Johnston	Leonard Johnston	9	3ft. 6in.	90	30 d.d.	1,150*	720	650 KW.	£146,876	£9,000*	563,595	3,902,077	*Lg. and tr. station
62	GOSPORT & FAREHAM	Provincial Tramways Co.	1906 (Jan.)	J. Fereday Glenn	J. F. Glenn J. Glenn (Cons.)	6½	4ft. 7¾in.	95	18 d.d. (3	750							Power station part D

ELECTRIC TRAMWAYS AND RAILWAYS IN THE UNITED KI

gers ed n.	Remarks.	
96	*Lg. & tr. station; see other table	1
36	.. ..	2
2	*Lg. & tr. station	3
50	*Lg. & tr. station	4
	*Lg. & tr. station. †Inc. bascule bridge ..	5
	*Energy purchased from Corporation ..	6
1	*Energy purchased from Corporation of Barrow-in-Furness	7
3	.. ..	8
	*Leased to Yorkshire Woollen District Elec. Tramways	9
7	*Lg. & tr. stn. (1,200 KW. for ltg.) †Inc. £412,734 purchase and expenses	10
7	*Lg. & tr. station	11
4	.. ..	12
9	*Four miles leased by Aston Corporation †Two stations	13
	.. ..	14
5	*Lg. & tr. station; see other table	15
2	*Lg. & tr. station	16
	.. ..	17
9	Figures approximate	18
	*Lg. & tr. station	19
	*Running leased to Liverpool Corpn. †Lg. & tr. station	20
	1.35 m. dble. track conduit. Powar for Poole and Christchurch supplied by Co.	21
	*Lg. & tr. station; see other table	22
	*Lg. & tr. station	23
	*Pioneer of electric traction in Gt. Britain. †Power from Corporation also	24
	Not running. Line to be reconstructed on 3ft. 6in. gauge	25
	.. ..	26
	*Lg. & tr. station	27
	*Line under construction. †Includes 2¾ miles belonging to Burton Corporation	28
	*Lg. & tr. station	29
	*Lg. & tr. station	30
	*2 Electric locos. & 16 trailers, 200 tons of tin ore daily. †Lg. & tr. station.	31
	Lg. dept. takes bulk supply from tramways at ld. p.u *Includes lg. load	32
	*Energy purchased from Corporation ..	33
	.. ..	34
	*Energy obtained from Cheltenham Corporation, lg. & tr. station	35
	*Lg. &tr. station	36
	*Lg. & tr. station. †Extra outlay for traction	37
	*Energy supplied by Dublin United Tramways Co.	38
	*Lg. & tr. station	39
	*Lg. & tr. station	40
	65 lb. rails Falk welded, 81 lb. rails Thermit welded	41
	* Lg. and tr. station	42
	*Energy purchased from Electricity Dept.	43
	*Lg. & tr. station. †Purchase £26,700, conversion £52,325	44
	* Lg. and tr. station	45
	4½ miles leased by Corp. *Power from Corp. lg. & tr. station	46
	*Lg. & tr. station	47
	* Lg. & tr. station. River Lt. Ry. operated by the Corpn.; figures included here	48
	D.C. to line at 500v. & A.C. 2,500v. to 3 sub-stations	49
	* Including conversion & alteration of gauge	50
	Power supplied by Dudley Corp. within the borough	51
	* Lg. and tr. station. † Exclusive of cables. Sunday running now adopted	52
	* Lg. and tr. station	53
	*Tramways proportion	54
	*Lg. and tr. station. †1½ miles in Kearsley leased to Farnworth	55
	Pier Electric Railway. *Energy supplied by Felixstowe Corporation	56
	.. ..	57
	This was the first Electric Tramway in the U. K.	58
	6,500 v. 3-ph. to rotary converter sub-stations	59
	* Including mains and car shed	60
	*Lg. and tr. station	61
	Power station part D.C., part A.C. with 2 sub-	62

		Locality	Lines Owned by	Year of opening.	Tramways Manager.	Tramways Electrical Engineer.	Miles of Route.	Gauge.	Weight of Rails per yard, lb.	Motor Cars.	Power Station. Total Capacity in KW.	Power Station. Max. load in KW.	Power Station. Battery max. discharge.	Capital Outlay on Tramways and Rolling Stock.
79	KEICHLEY	.. .. ..	Corporation	1904	J. W. Bamber .	J. M. Smyth ..	3¼	4ft. 0in.	95	10 d.d. ..	740	160	..	£35,000
80	KIDDERMINSTER AND STOURPORT		K. & S. Electric Tramway Co. ..	1898	W. Steadman ..	A. Charlton ..	4½	3ft. 6in.	75	4 d.d. 9 s.d.	1,050	..	750 A.H.	£60,000
81	KILMARNOCK	.. ..	Corporation	1904	Alf. H. Burbidge	Alf. H. Burbidge	4 29	4ft. 8½in.	90	14 d.d. ..	250	238	..	£54,000
82	KIRKCALDY	.. .. ..	Corporation	1898	O. F. Francis ..	O. F. Francis ..	5½	3ft. 6in.	87	22 d.d. ..	1,000	385	200 KW.	£88,700
83	LANCASTER	.. .. ..	Corporation	1903	W. A. Tester ..	W. A. Tester ..	4	4ft. 8½in.	90	10 d.d. ..	1,000	680	..	£36,200
84	LEEDS	.. ..	Corporation	1897	J. B. Hamilton	J. Burbridge ..	42½	4ft. 8½in.	100 & 105	244 d.d. 1 s.d.	4,150	3,500	..	£1,040,000
85	LEICESTER	.. .. ..	Corporation	1904	A. F. Lucas ..	T. R. Smith ..	23	4ft. 8½in.	100	140 d.d., 20 covered	2,500	1,600	450 KW.	£673,170
86	LEYTON	.. .. ..	Urban District Council	1906	F. Schofield ..	F. Harman Lewis	9½	4ft. 8½in.	105	40 d.d. ..	..	..	..	..
87	LIVERPOOL	.. .. ..	Corporation	1898	C. W. Mallins ..	A. Clough (res.)* A.B.Holmes (cons.)	57½	4ft. 8½in.	95	467 d.d., 12 s.d.	27,670*	15,752*	*	£1,898,812
88	LIVERPOOL—PRESCOT	..	Lancashire Light Railway Co. Ld.	1902	J. R. Salter ..	J. R. Salter ..	3	4ft. 8½in.	..	7 d.d. ..	..	..	..	..
89	LONDON (SOUTH)	.. ..	London County Council	1903	A. L. C. Fell ..	J. H. Rider ..	30	4ft. 8½in.	102	401 d.d. 16 s.d.	14,000	6,000*	..	..
90	LOWESTOFT	.. .. ..	Corporation	1903	G. A. Bruce ..	G. A. Bruce ..	4	3ft. 6in.	100	15 d.d., 4 s.d.	*	..	..	£78,000
91	MAIDSTONE	.. .. ..	Corporation	1904	E. E. Hoadley ..	E. E. Hoadley ..	2	3ft. 6in.	96	7 d.d. ..	300	150*	150 KW.	£25,000
92	MANCHESTER	.. ..	Corporation	1901	J. M. McElroy ..	J. J. MacMahon	84	4ft. 8½in.	102	517 d.d. 25 comb.	..	..	..	£1,587,000
93	MERTHYR TYDFIL	.. ..	Merthyr Elec. Traction & Lg. Co.	1901	Geo. Charlton (Man. Eng.)	R. L. McCullock (Traffic upt.)	2·98	3ft. 6in.	96	3 d.d. 12 s.d.	930*	394 (tr.)*	100 KW.	£72,100
94	MIDDLESBROUCH	.. ..	Imperial Tramways Co.	1898	Sir J. C. Robinson	Sir J.C. Robinson	9	3ft. 6in.	92.5	50	900	..	..	..
95	MIDDLETON, ROCHDALE AND OLDHAM		Middleton Electric Traction Co...	1902	W. F. Endean ..	.. .. ..	8½	4ft. 8½in.	90	5 d.d. 18 s.d.	*	..	..	£158,000
96	NELSON	.. .. ..	Corporation	1903	M. B. Henry ..	M. B. Henry ..	2⅝	4ft. 0in.	107	4 comb. 6 d.d., 20 comb.	1,000*	700*	..	£33,000 (130
97	NEWCASTLE-ON-TYNE	..	Corporation	1901	Ernest Hatton ..	Ernest Hatton ..	25.3	4ft. 8½in.	102	75 d.d. 88 s.d. 22 comb.	5,100	2,500	500 KW.	£924,000
98	NEWPORT (MON.)	.. ..	Corporation	1903	H. Collings Bishop	H. Collings Bishop	7½	4ft. 8½in.	96	40 d.d. ..	*	..	*	£188,300
99	NORTHAMPTON	.. ..	Corporation	1904	J. Gottschalk ..	J. McMahon ..	5½	3ft. 6in.	90	22 d.d. ..	650	350	150 KW.	£115,100
100	NORWICH	.. .. ..	Norwich Electric Tramways Co...	1900	A. N. Banister ..	A. N. Banister ..	14⅜	3ft. 6in.	65.5	42 d.d. ..	800	500	..	£320,000 inclusive
101	NOTTINGHAM	.. ..	Corporation	1901	J. Aldworth ..	H. Talbot	16½	4ft. 8½in.	107	105 d.d. ..	8,576*	..	100 KW.	£5 0.2
102	OLDHAM	.. .. ..	Corporation	1900	Lewis Slattery ..	S. W. Newington	23	4ft. 8½in.	100	57 d.d., 23 s.d.	2,565*	1,485	..	£449,100
103	OLDHAM, ASHTON & HYDE		O., A. & H. Electric Tramway ..	1899	M. Rathborne ..	E. T. Todd ..	9½	4ft. 8½in.	95	12 d.d. 34 s.d.	*	..		£153,000
104	PAISLEY, JOHNSTON, BARRHEAD, RENFREW, AND KILBARCHAN		Paisley District Tramway Co. ..	1904	Fred Coutts ..	Fred Coutts .. H.F.Parshall, cons.	14	4ft. 7½in.	90	19 d.d. ..	*	..	..	..
105	PERTH	.. .. ..	Corporation	1905 (Oct.)	John Lambert ..	John Lambert ..	5.8	3ft. 6in.	90	12 d.d. ..	*	..	..	..
106	PETERBOROUCH	.. ..	Peterborough Electric Traction Co.	1908	.. .. ..	.. .. ..	5.31	3ft. 6in.	94	14 d.d. ..	*	..	..	£62,200
107	PLYMOUTH	.. .. ..	Corporation	1899	C. R. Everson ..	E. G. Okell ..	4.1	3ft. 6in.	92	26	700	..	1,140 KW. hrs.	£117,000
108	PLYMOUTH, STONEHOUSE, AND DEVONPORT		P., S. & D. Tramways Co. ..	1901	G. H. Moreton..	John Glenn ..	1½	3ft. 6in.	84	13 d.d. ..	..	..	..	..
109	PONTYPRIDD	.. ..	Urban District Council	1905	J. E. Teasdel ..	J. E. Teasdel ..	3¾	3ft. 6in.	96	6 d.d., 6 comb.	600*	..	*	£65,000
110	PORTSDOWN AND HORNDEAN		Provincial Tramways Co... ..	1903	J. F. Glen ..	J. F. Glenn .. J. Glenn (cons.)	6	4ft. 7½in.	96	16 d.d. ..	500	..	..	..
111	PORTSMOUTH	.. ..	Corporation	1901	W. R. Spaven ..	V. G. Liront ..	14½	4ft. 7½in.	96	84 d.d. ..	1,100	1,400	..	£600,000
112	POTTERIES	.. ..	Potteries Electric Traction Co. ..	1899	J. J. Walklate ..	.. .. ..	31.68	4ft. 0in.	87	105	2,100	..	..	£508,670 inclusive
113	PRESTON	.. .. ..	Corporation	1904	Jos. F. Simpson	Jos. F. Simpson	10	4ft. 8½in.	95	30 d.d. ..	600	450	..	£1
114	READING	.. .. ..	Corporation	1903	Walter Binns ..	Walter Binns ..	7½	4ft. 0in.	96	36 d.d. (inc. 6 bogie)	400	500	..	£223,500
115	ROCHDALE	.. .. ..	Corporation	1902	J. S. D. Moffet	C. C. Atchison..	19½	4ft. 8½in.	103	34 d.d., 15 s.d. comb.	2,176*	517 tr.	..	£328,000
116	ROTHERHAM	.. .. ..	Corporation	1903	E. Cross.. ..	E. Cross.. ..	9¾	4ft. 8½in.	88.5	27 d.d., 3 s.d.	665	385	..	£18,300
117	ROTHESAY	.. .. ..	Rothesay Tramways Co.	1902	A. Robertson ..	A. Wilkes ..	4.81	3ft. 6in.	97	20	350	..	350 A.H.	£117,900 inclusive
118	SALFORD	.. .. ..	Corporation	1901	G. W. Holford ..	C. D. Taite ..	30	4ft. 8½in.	103	100	6,400*	..	1,200 A.H.	..
119	SCARBOROUCH	.. ..	Scarborough Tramways Co. ..	1904	W. E. Nicoll ..	W. E. Nicoll ..	4½	3ft. 6in.	90	22 d.d., 7 regen.	*	..	..	£97,410
120	SEAFORTH & CT. CROSBY		Liverpool Overhead Ry. Co. ..	1900	S. B. Cottrell ..	S. B. Cottrell ..	2½	4ft. 8½in.	92½	12 d.d., 2 s.d.	160*	..	1,300 A.H.	£50,000
121	SHEERNESS	.. .. ..	Sheerness & Dist. Elec. Pr. & Tr. Co.	1903	A. A. Watkins ..	A. A. Watkins ..	2½	3ft. 6in.	94	8 d.d. ..	360	216	240 KW.	£64,000 inclusive
122	SHEFFIELD	.. .. ..	Corporation	1899	A. R. Fearnley ..	H. E. Yerbury ..	35¾	4ft. 8½in.	108½	181 d.d. 69 s.d.	3,875	3,000	..	£861,700
123	SHIPLEY	.. .. ..	Urban District Council	1902	C. J. Spencer ..	S. D. Schofield..	6	4ft. 0in.	98	*	1,170†	540	150 KW.	..
124	SOUTHAMPTON	.. ..	Corporation	1900	H. F. Street ..	H. F. Street ..	11	4ft. 8½in.	98	49 d.d. ..	1,360	..	1,500 KW.	£183,400
125	SOUTHEND-ON-SEA	.. ..	Corporation	1901	.. .. ..	.. .. ..	7½	3ft. 6in.	90	20 d.d. 2 s.d.	1,300	300 tr.	..	£73,200
126	SOUTH LANCASHIRE	..	South Lancashire Tramways Co.	1902	J. R. Salter ..	J. R. Salter ..	22½	4ft. 8½in.	90	45 d.d. 1 s.d.	1,750*	1,000	720 KW.	£550,000
127	SOUTHPORT	.. .. ..	Corporation*..	1900	T. J. Kendrew ..	R. S. Downe ..	8½	4ft. 8½in.	87	17 d.d., 1 s.d. 8 comb.	2,350*	1,435	..	£118,400
128	SOUTHPORT AND BIRKDALE		Southport Tramways Co.	1901	J. Lloyd.. ..	H. Bentham ..	8.17	4ft. 8½in.	87	20 d.d., 1 regen.	..	..	..	£85,000
129	SOUTHPORT PIER	.. ..	Southport Pier Co.	..	. .. ..	.. .. ..	0.6	3ft. 6in.	..	1 s.d. (demi-car) 3 s.d.	..	..	..	inc. pier
130	SOUTH STAFFORDSHIRE	..	South S. Tramways Lessee Co. ..	1902	R. W. Cramp (Traffic) ..	G. Conaty (Eng. Man.) ..	14¾	3ft. 6in.	76 & 96	43 d.d. ..	273	190	..	..
131	STALYBRIDGE, HYDE DUKINFIELD & MOSSLEY		Stalybridge, Hyde, Dukinfield & Mossley Tramway Board	1904	.. .. ..	R. Blackmore ..	25	4ft. 8½in.	99	35 d.d., 20 s.d.	1,500	1,000	750 A.H.	£255,700
132	ST. HELENS, PRESCOT, RAINHILL HUYTON & DIST.		Corporation; leased to New St. Helens & District Tramway Co.	1899	William Hutchings	E. M. Hollingsworth	20½	4ft. 8½in.	97	36 d.d. ..	..	..	..	£123,100
133	STOCKPORT & DISTRICT		Corporation	1901	A. T. Eardley ..	A. J. H. Carter..	15½	4ft. 8½in.	99	45 d.d. ..	1,548*	848	40 KW. for 6 hrs.	£134,900
134	SUNDERLAND	.. ..	Corporation	1900	A. R. Dayson ..	J. F. C. Snell, con. A. R. Dayson, res.	10¾	4ft. 8½in.	96	52 d.d. 8 s.d. 4 comb.	1,600	742	..	£285,800
135	SUNDERLAND & DISTRICT		Sunderland & Dist. Elec. Tramways	1905	R. D. McCarter (gen. man. & eng.)	H. S. Watkins (res.)	13½	4ft. 8½in.	90	30 d.d. ..	*	..	..	..
136	SUTTON & HOWTH	..	Great Northern Ry. Co. (Ireland)	1901	H. Plews ..	A. W. Whieldon	5¾	5ft. 3in.	72	10 d.d. 1 s.d.	550	470	150 KW.	..
137	SWANSEA	.. .. .	Swansea Improvements & Try. Co.	1900	D. James ..	A. Johnston ..	12.43*	4ft. 8½in.	87-95	23 d.d. 30 s.d. 12 comb.	660*	420*	..	£244,200 inc. pur
138	SWINDON	.. .. ..	Corporation	1904	J. G. Griffin, g.m., T. Medcalf, t.m.	J. G. Griffin ..	3.7	3ft. 6in.	105	12 d.d. ..	900*	200 (tr.)	..	£41,400
139	TAUNTON	.. .. ..	Taunton & W. Somerset El. Rys.	1901	W. Smith ..	.. .. ..	1¼	3ft. 6in.	90	6 s.d. ..	200*	..	..	£23,600
													..	£96,97 inc. pur

REVIEW" LIST OF ELECTRIC TRAMWAYS AND RAILWAYS

	Locality	Lines Owned by	Year of opening.	Tramways Manager.	Weight of Rails per yard, lb.	Motor Cars.	Power Station. Total Capacity in KW.	Power Station. Max. load in KW.	Power Station. Battery max. discharge.	Capital Outlay on Tramway and Rolling Stock.	Capital Outlay on Power Station.	Annual Electric Car Mileage.	Passengers Carried per Annum.	Remarks.	
1	KEICHLEY	Corporation	1904	J. W. Bamber	98	69 d.d.	2,766	400 ave.	90 KW	£331,434	*	1,617,525	17,142,896	*Lg. & tr. station; see other table	1
2	KIDDERMINSTER AND STOURPORT	K. & S. Electric Tramway Co.	1898	W. Steadman	94	20 d.d.				£61,441		267,942 (1905)	2,977,936 (1905)		2
3	KILMARNOCK	Corporation	1901	Alf. H. Burbidge	96	6 d.d., 6 comb.	1,200	624		£101,451		353,748	4,116,012	*Lg. & tr. station	3
4	KIRKCALDY	Corporation	1898	O. F. Francis	96	18 d.d.	1,175*		100 KW.	£80,000	£83,000*	365,646	3,578,650	*Lg. & tr. station	4
5	LANCASTER	Corporation	1903	W. A. Tester	80	7 d.d.	450	130		£50,000†	*			*Lg. & tr. station. †Inc. bascule bridge	5
6	LEEDS	Corporation	1897	J. B. Hamilton	94	12				£65,381	*	204,982		*Energy purchased from Corporation	6
7	LEICESTER	Corporation	1904	A. F. Lucas	94	9 d.d. 7 s.d. (2 demi-cars reg.)						331,795	3,008,511	*Energy purchased from Corporation of Barrow-in-Furness	7
8	LEYTON	Urban District Council	1906	F. Schofield	95	34 d.d., 6 comb.	675					967,637	6,746,363		8
9	LIVERPOOL	Corporation	1898	C. W. Mallins	104	50 d.d. 8 s.d.	850	350	90 KW.		£36,068			*Leased to Yorkshire Woollen District Elec. Tramways	9
10	LIVERPOOL—PRESCOT	Lancashire Light Railway Co. Ltd.	1902	J. R. Salter	105	220 d.d.	4,200			£952,790†	£77,486	5,169,306	30,133,027	Lg. & tr. stn. (1,200 KW. for ltg.) †Inc. £412,734 purchase and expenses	10
11	LONDON (SOUTH)	London County Council	1903	A. L. C. Fell	90	16 d.d.	300 (tr.)	198	137 KW.	£71,267	£21,000	258,319	1,677,637	*Lg. & tr. station	11
12	LOWESTOFT	Corporation	1903	G. A. Bruce	100	46 d.d., 14 s.d.	1,475	1,343	240 KW.	£297,670	£53,141	1,319,079	11,052,114		12
13	MAIDSTONE	Corporation	1904	E. E. Hoadley	90 & 97	97 d.d. s.t., 3 bo. 6 toastrack	1,098			£617,078 inc. stns.		2,312,084	19,011,789	†Four miles leased by Aston Corporation †Two stations	13
14	MANCHESTER	Corporation	1901	J. M. McElroy		51 d.d. (inc. 26 regen.), 8 s.d.	2,490								14
15	MERTHYR TYDFIL	Merthyr Elec. Traction & Lg. Co.	1901	Geo. Charlton (Man. Eng.)	92	48 d.d.	4,518			£320,563		974,031	9,289,035	*Lg. & tr. station; see other table	15
16	MIDDLESBROUCH	Imperial Tramways Co.	1898	Sir J. C. Robinson	95	61 d.d.	1,150*	690	1,680 A.H.	£281,364	£188,155*	909,746	7,362,132	*Lg. & tr. station	16
17	MIDDLETON, ROCHDALE AND OLDHAM	Middleton Electric Traction Co.	1902	W. F. Endean	98, 83, 56	31 s.d.	600	480	380 KW.	£198,127		579,264	2,325,677		17
18	NELSON	Corporation	1903	M. B. Henry	90	20 closed, 20 open d.t.						450,000	2,500,000	Figures approximate	18
19	NEWCASTLE-ON-TYNE	Corporation	1901	Ernest Hatton	96	86 d.d.	5,200	1,600 tr. only		£462,780	£269,818*	2,235,180	21,390,116	*Lg. & tr. station	19
20	NEWPORT (MON.)	Corporation	1903	H. Collings Bishop	90		2,050*		500 A.H.	£75,616	£17,227			*Running leased to Liverpool Corpn. †Lg. & tr. station	20
21	NORTHAMPTON	Corporation	1904	J. Gottschalk	90, 100, 105	70 d.d., 1 saloon	1,200	1,000		£270,000 ex extens.	£75,000	1,121,623 (1905)	10,058,288 (1905)	1.35 m. dble. track conduit. Power for Poole and Christchurch supplied by Co.	21
22	NORWICH	Norwich Electric Tramways Co.	1900	A. N. Banister	102	238 d.d., 1 s.d.						5,034,154	45,331,288	*Lg. & tr. station; see other table	22
23	NOTTINGHAM	Corporation	1901	J. Aldworth	101	50 d.d.	780	913	550 KW.	£242,811	*	1,152,828	11,321,227	*Lg. & tr. station	23
24	OLDHAM	Corporation	1900	Lewis Slattery	35	8	60	40	36 KW.	£10,000		80,000	720,000	*Pioneer of electric traction in Gt. Britain. †Power from Corporation also	24
25	OLDHAM, ASHTON & HYDE	O., A. & H. Electric Tramway	1899	M. Rathborne										Not running. Line to be reconstructed on 3ft. 6in. gauge	25
26	PAISLEY, JOHNSTON, BARRHEAD, RENFREW, AND KILBARCHAN	Paisley District Tramway Co.	1904	Fred Coutts	92½	234 d.d.	2,150			£1,314,026		6,127,135	45,294,177		26
27	PERTH	Corporation	1905 (Oct.)	John Lambert	102	24	1,140*		190 KW.	£168,000	*			*Lg. & tr. station	27
28	PETERBOROUCH	Peterborough Electric Traction Co.	1908		90	13 d.d.	330		440					*Line under construction. †Includes 2¼ miles belonging to Burton Corporation	28
29	PLYMOUTH	Corporation	1899	C. R. Everson	90	20 d.d.	400 (tr.)	250		£86,500	£71,679*	454,082	3,878,269	*Lg. & tr. station	29
30	PLYMOUTH, STONEHOUSE, AND DEVONPORT	P., S. & D. Tramways Co.	1901	G. H. Moreton	102½	34 d.d.	1,200*	715		£215,000	£77,553	495,079	3,916,590	*Lg. & tr. station	30
31	PONTYPRIDD	Urban District Council	1905	J. E. Teasdel	90	6 d.d., 2 s.d.*	480	250	200 KW.	£45,690	£42,082†	147,706	1,079,841	*2 Electric locos. & 16 trailers, 200 tons of tin ore daily. †Lg. & tr. station.	31
32	PORTSDOWN AND HORNDEAN	Provincial Tramways Co.	1903	J. F. Glen	100	100 d.d. 14 s.d. 16 comb.	5,400	3,260	150 KW.	£747,308 inclusive		2,624,840	24,127,641	Lg. dept. takes bulk supply from tramways at 1d. p.u. *Includes lg. load	32
33	PORTSMOUTH	Corporation	1901	W. R. Spaven	87	12 d.d. 3 s.d.				£101,183		359,756	2,935,002	*Energy purchased from Corporation	33
34	POTTERIES	Potteries Electric Traction Co.	1899	J. J. Walklate	92½ & 115	40 d.d.	675	686		£161,937	£59,705 inc. car shed	862,555	7,378,893		34
35	PRESTON	Corporation	1904	Jos. F. Simpson	83	18 d.d., 2 s.d.	330*	360 approx.	150 KW.*	£186,000 autbd.		461,931	2,987,858	*Energy obtained from Cheltenham Corporation, lg. & tr. station	35
36	READING	Corporation	1903	Walter Binns	92	12 d.d.	1,250	831	235 KW.			270,210.5	2,176,228	*Lg. &tr. station	36
37	ROCHDALE	Corporation	1902	J. S. D. Moffet	96	12 d.d.	1,000* lg. & tr.	200		£60,000	£7,000†	269,000	2,183,480	*Lg. & tr. station. †Extra outlay for traction	37
38	ROTHERHAM	Corporation	1903	E. Cross	60, 83, 95	12				£72,500		152,000	524,000	*Energy supplied by Dublin United Tramways Co.	38
39	ROTHESAY	Rothesay Tramways Co.	1902	A. Robertson	95	16 d.d.				£67,000		325,000	2,500,000	*Lg. & tr. station	39
40	SALFORD	Corporation	1901	G. W. Holford	83	35 d.d.	1,700	400		£173,612		900,446	5,979,882	*Lg. & tr. station	40
41	SCARBOROUCH	Scarborough Tramways Co.	1904	W. E. Nicoll	81, 84 65	30 d.d.	400					675,374	3,958,850	65 lb. rails Falk welded, 81 lb. rails Thermit welded	41
42	SEAFORTH & CT. CROSBY	Liverpool Overhead Ry. Co.	1900	S. B. Cottrell	95	60 d.d.	1,950	650		£232,127		1,644,327 (1905)	14,732,446 (1905)	* Lg. and tr. station	42
43	SHEERNESS	Sheerness & Dist. Elec. Pr. & Tr. Co.	1903	A. A. Watkins	90	16 s.d.				£75,000		375,755	3,985,150	*Energy purchased from Electricity Dept.	43
44	SHEFFIELD	Corporation	1899	A. R. Fearnley	95½	14 d.d., 1 s.d.	900	300 tr. only	92 KW. for 2 hrs.	£85,000†		240,000	2,400,000	*Lg. & tr. station. †Purchase £26,700, conversion £52,326	44
45	SHIPLEY	Urban District Council	1902	C. J. Spencer	95	35 d.d., 4 s.d.	800*	410	190 KW.*	£136,573	£12,000 (tr. only)	766,183	7,658,537	* Lg. and tr. station	45
46	SOUTHAMPTON	Corporation	1900	H. F. Street	92	25 d.d.	1,860	550*	460 KW.	£162,045		564,990	4,974,319	4½ miles leased by Corp. *Power from Corp. lg. & tr. station	46
47	SOUTHEND-ON-SEA	Corporation	1901		100	25 d.d.	660*	440		£59,077	*	436,603	2,443,998	*Lg. & tr. station	47
48	SOUTHPORT	Corporation*	1900	T. J. Kendrew	87	21 d.d.	200		280 KW. hours	£41,850		303,153 (1905-6)	2,885,918	* Lg. & tr. station. River Lt. Ry. operated by the Corpn.; figures included here	48
49	SOUTHPORT AND BIRKDALE	Southport Tramways Co.	1901	J. Lloyd	92	291 d.d., 3 s.d.	3,300	2,150		£1,900,000 inclusive		990,288	49,745,225	D.C. to line at 500v. & A.C. 2,500v. to 3 sub-stations	49
50	SOUTHPORT PIER	Southport Pier Co.			50	5 d.d., 18 wgs., 1 loco.	240	200		£69,201*		112,704	396,032	* Including conversion & alteration of gauge	50
51	SOUTH STAFFORDSHIRE	South S. Tramways Lessee Co.	1902	R. W. Cramp (Traffic)	90	24 d.d. 35 s.d.	700		325 KW.	£372,020			8,370,791	Power supplied by Dudley Corp. within the borough	51
52	STALYBRIDGE, HYDE DUKINFIELD & MOSSLEY	Stalybridge, Hyde, Dukinfield & Mossley Tramway Board	1904		92, 95	48 d.d., 6 comb.	1,283			£266,884†		933,006 (1905)	11,641,525 (1905)	* Lg. and tr. station. † Exclusive of cables. Sunday running now adopted	52
53	ST. HELENS, PRESCOT, RAINHILL HUYTON & DIST.	Corporation; leased to New St. Helens & District Tramway Co.	1899	William Hutchings	90	40 d.d.	1,925 tr. 450	1,050*		£152,277 (1905)	£117,286* (1905)	981,812	13,689,658 (1905)	*Lg. and tr. station	53
54	STOCKPORT & DISTRICT	Corporation	1901	A. T. Eardley		14 d.d.				£55,000	£9,000*			*Tramways proportion	54
55	SUNDERLAND	Corporation	1900	A. R. Dayson	98	13 d.d.	610	160 tr. only		£43,696 & £25,000†		242,524	1,532,293	*Lg. and tr. station. †1½ miles in Kearsley leased to Farnworth	55
56	SUNDERLAND & DISTRICT	Sunderland & Dist. Elec. Tramways	1905	R. D. McCarter (gen. man. & eng.)	36	2 m.cars, 1 trailer								Pier Electric Railway. *Energy supplied by Felixstowe Corporation	56
57	SUTTON & HOWTH	Great Northern Ry. Co. (Ireland)	1901	H. Plews	90	25 d.d. 15 s.d., 10 comb.						1,266,325	11,285,769		57
58	SWANSEA	Swansea Improvements & Try. Co.	1900	D. James	43	3 s.d., 19 tr.	100	90		£55,472		85,947	128,546	This was the first Electric Tramway in the U. K.	58
59	SWINDON	Corporation	1901	J. G. Griffin	100	660 d.d. 21 s.d.	11,200	7,500		£1,617,368	£956,892	14,008,750	117,179,547	6,500 v. 3-ph. to rotary converter sub-stations	59
60					90	7 d.d., 1 s.d.	225	251	600 A.H.	£54,163	£48,037*	175,315	1,373,487	*Including mains and car shed	60

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LWAYS IN THE UNITED KINGDOM.

								Power Station.											
Year of opening.	Tramways Manager.	Tramways Electrical Engineer.	Miles of Route.	Gauge.	Weight of Rails per yard, lb.	Motor Cars.	Total Capacity in KW.	Max. load in KW.	Battery max. discharge.	Capital Outlay on Tramway and Rolling Stock.	Capital Outlay on Power Station.	Annual Electric Car Mileage.	Passengers Carried per Annum.	Remarks	
1904	J. W. Bamber	J. M. Smyth	3¼	4ft. 0in.	96	10 d.d.	740*	160	..	£35,000	£42,000*	267,000	1,700,000	*Lg. and tr. station	79
1898	W. Steadman	A. Charlton	4½	3ft. 6in.	75	4 d.d. 9 s.d.	1,050*	..	750 A.H.	£60,696	*	198,491	834,211	*Energy purchased from Kidderminster & Dist. Elec. L. & Tr. Co.	80
1904	Alf. H. Burbidge	Alf. H. Burbidge	4·29	4ft. 8½in.	90	14 d.d.	250*	238	..	£54,000	*	299,643	2,180,263	*Lg. & tr. station	81
1898	O. F. Francis	O. F. Francis	5¼	3ft. 6in.	87	22 d.d.	1,000*	385	200 KW.	£88,715	..	432,296	3,632,855	*Lg and tr. station	82
1903	W. A. Tester	W. A. Tester	4	4ft. 8½in.	90	10 d.d.	1,000*	680	..	£36,281	£36,371*	195,411	1,251,612	*Lg. & tr. station	83
1897	J. B. Hamilton	J. Burbridge	42½	4ft. 8½in.	100 & 105	244 d.d. 1 s.d.	4,150	3,500	..	£1,040,006*	..	6,091,437	60,739,234	*Inc. purchase of lines	84
1904	A. F. Lucas	T. R. Smith	28	4ft. 8½in.	100	140 d.d., 20 covered	2,500	1,600	450 KW.	£673,178	£83,523	3,342,248	25,890,030		85
1906	F. Schofield	F. Harman Lewis	9½	4ft. 8½in.	105	40 d.d.	*	*	..	..	*	..	..	In course of conversion; expect to start elec. operation Oct. 1906. *Lg. & tr. stn.	86
1898	C. W. Mallins	A. Clough (res.)* A.B.Holmes (cons.)	57½	4ft. 8½in.	95	467 d.d., 12 s.d.	27,670*	15,752*	*	£1,898,812	£1,849,775*	12,067,033	119,123,644	Combined lg., pr, and tr. stations	87
1902	J. R. Salter	J. R. Salter	3	4ft. 8½in.	..	7 d.d.	*	..	..	..	*	..	..	*Energy from Prescot lg. and tr. station	88
1903	A. L. C. Fell	J. H. Rider	30	4ft. 8½in.	102	401 d.d. 16 s.d.	14,000	6,000*	..	..	..	12,164,292	141,845,555	*Load May, 1906; increasing with new lines	89
1903	G. A. Bruce	G. A. Bruce	4	3ft. 6in.	100	15 d.d., 4 s.d.	*	..	..	£78,931	*	314,962	2,388,223	*Lg. and tr. station	90
1904	E. E. Hoadley	E. E. Hoadley	2	3ft. 6in.	96	7 d.d.	300*	150*	150 KW.	£25,000	£55,000*	156,000	1,200,000	*Lg. and tr. station	91
1901	J. M. McElroy	J. J. MacMahon	84	4ft. 8½in.	102	517 d.d. 25 comb.	*	..	..	£1,587,931	*	14,123,124	126,900,875	*Lg. & tr. stations	92
1901	Geo. Charlton (Man. Eng.)	R. L. McCulloch (Traffic upt.)	2·98	3ft. 6in.	96	3 d.d. 12 s.d.	930*	394 (tr.)*	100 KW.	£62,138	£43,597* inc. mains	247,940	1,882,437	*Lg. & tr. station	93
1898	Sir J. C. Robinson	Sir J.C. Robinson	9	3ft. 6in.	92.5	50	900	..	..	..	..	..	..	..	94
1902	W. F. Endean	..	8½	4ft. 8½in.	90	5 d.d. 18 s.d. 4 comb.	*	..	..	£158,921	£88,000	493,822	3,575,112	*Energy purchased from Local Authorities	95
1903	M. B. Henry	M. B. Henry	2⅔	4ft. 0in.	107	6 d.d., 20 comb.	1,000*	700*	..	£33,313 (1905)	£70,122* (1905)	208,334	1,915,586	*Lg. & tr. station	96
1901	Ernest Hatton	Ernest Hatton	25.3	4ft. 8½in.	102	75 d.d. 88 s.d. 22 comb.	5,100	2,500	500 KW.	£924,669	£196,258	4,326,152	43,070,000	..	97
1903	H. Collings Bishop	H. Collings Bishop	7½	4ft. 8½in.	96	40 d.d.	*	..	*	£188,313	*	783,495	7,252,535	*Lg. and tr. station	98
1904	J. Gottschalk	J. McMahon	5½	3ft. 6in.	90	22 d.d.	650	350		£115,165	£12,937	526,067	5,041,230	..	99
1900	A. N. Banister	A. N. Banister	14⅔	3ft. 6in.	65.5	42 d.d.	800	500	150 KW.	£320,000 inclusive	..	1,083,055	7,409,126	..	100
1901	J. Aldworth	H. Talbot	16¼	4ft. 8½in.	107	105 d.d.	8,576*	..	100 KW.	£510,239	*	2,549,290	27,518,200	*Lg. and tr. station	101
1900	Lewis Slattery	S. W. Newington	23	4ft. 8½in.	100	57 d.d., 23 s.d.	2,565*	1,485*	..	£440,168	£223,341	1,753,546	16,668,026	*Lg. and tr. station	102
1899	M. Rathborne	E. T. Todd	9⅛	4ft. 8½in.	96	12 d.d. 34 s.d.	*	..	*	£153,922	..	858,320	5,817,155	*Energy purchased from Ashton Corporation	103
1904	Fred Coutts	Fred Coutts H.F.Parshall, cons.	14	4ft. 7½in.	90	49 d.d.	*	..	..	..	*	900,000	10,000,000	*Energy from Paisley Corporation lg. and tr. station; see other Table	104
1905 (Oct.)	John Lambert	John Lambert	5.8	3ft. 6in.	90	12 d.d.	*	..	..	..	*	..	..	*Energy from Corporation lg. and tr. station; see other Table	105
1908	..	..	5.31	3ft. 6in.	94	14 d.d.	*	..	..	£62,290	*	272,873	1,928,781	*Energy purchased from Corporation	106
1899	C. R. Everson	E. G. Okell	4.1	3ft. 6in.	92	26	700*	..	1,140 KW. hrs.	£117,000	*	..	..	*Lg. & tr. station	107
1901	G. H. Moreton	John Glenn	1½	3ft. 6in.	84	13 d.d.	*	..	..	..	*	..	..	*Energy from Devonport Corporation lg. and tr. station; see other Table	108
1905	J. E. Teasdel	J. E. Teasdel	3½	3ft. 6in.	96	6 d.d., 6 comb.	600*	..		£65,000	£55,000*	236,580	1,738,921	*Lg. and tr. station	109
1903	J. F. Glen	J. F. Glenn J. Glenn (cons.)	6	4ft. 7⅞in.	96	16 d.d.	500	..	..	..	..	..	..	J. B. Glenn, Sec. and Man. Dir.	110
1901	W. R. Spaven	V. G. Lironi	14½	4ft. 7½in.	96	84 d.d.	1,100	1,400	..	£600 405*	£49 545	2,111,350	20,141,674	*Including purchase	111
1899	J. J. Walklate	..	31.68	4ft. 0in.	87	105	2,100	..	..	£508,613 inclusive.	..	2,377,556	17,424,667	..	112
1904	Jos. F. Simpson	Jos. F. Simpson	10	4ft. 8½in.	95	30 d.d.	600	450	..	£197, 000		789,383	7,234,494	..	113
1903	Walter Binns	Walter Binns	7½	4ft. 0in.	96	36 d.d. (inc. 6 bogie)	400	500	..	£223,502*	£30,000 (exc. site)	877,646	7,952,070	* Including purchase of horse tramways, £31,658	114
1902	J. S. D. Moffet	C. C. Atchison	19½	4ft. 8½in.	103	34 d.d., 15 s.d. comb.	2,176*	517 tr.	..	£328,024†	£66,414*	962,353	7,612,524	*Lg. & tr. station. † Inc. £71,000, purchase of Bury, R. & Oldham Trys. in R. dist.	115
1903	E. Cross	E. Cross	9⅓	4ft. 8½in.	88.5	27 d.d., 3 s.d.	665*	385	..	£18,350	£12,946*	578,955	5,342,566	*Lg. & tr. station	116
1902	A. Robertson	A. Wilkes	4.81	3ft. 6in.	97	20	350	..	350 A.H.	£117,949 inclusive	..	209,402	1,172,779	..	117
1901	G. W. Holford	C. D. Taite	30	4ft. 8½in.	103	100	6,400*	..	1,200 A.H.	..	*	..	..	*Lg. & tr. station	118
1904	W. E. Nicoll	W. E. Nicoll	4½	3ft. 6in.	90	22 d.d., 7 regen.	*	..	..	£97,446	*	233,000	1,800,000	*Energy from Scarboro' Electric Supply Co.	119
1900	S. B. Cottrell	S. B. Cottrell	2½	4ft. 8½in.	92½	12 d.d., 2 s.d.	160*	..	1,300 A.H.	£50,000	*	288,065	2,294,317	*Energy from Liverpool Overhead Ry. power station	120
1903	A. A. Watkins	A. A. Watkins	2½	3ft. 6in.	94	8 d.d.	360	216	240 KW.	£64,088 inclusive	..	168,183	849,088	Bow trolley	121
1899	A. R. Fearnley	H. E. Yerbury	35¾	4ft. 8½in.	108½	181 d.d. 69 s.d.	3,675	3,000	..	£861,769	£126,528	5,768,231	61,450,993	..	122
1902	C. J. Spencer	S. D. Schofield	6	4ft. 0in.	98	*	1,170†	540	150 KW.	..	£56,250*	*	*	*Leased to Bradford Corporation. †Lg. & tr. station	123
1900	H. F. Street	H. F. Street	11	4ft. 8½in.	98	49 d.d.	1,360*	..	1,500 KW.	£183,479	*	924,129	9,314,946	*Lg. & tr. station	124
1901	..	..	7½	3ft. 6in.	90	20 d.d. 2 s.d.	1,300*	300 tr.	..	£73,290	£63,029	385,000	4,903,000	*Lg. & tr. station	125
1902	J. R. Salter	J. R. Salter	22½	4ft. 8½in.	90	45 d.d. 1 s.d.	1,750*	1,000	720 KW.	£550,000	*	1,230,707	5,865,969	*Lg. & tr. station	126
1900	T. J. Kendrew	R. S. Downe	8½	4ft. 8½in.	87	17 d.d., 1 s.d. 8 comb.	2,350†	1,435	..	£118,483	*	441,712	3,874,610	*Part leased to Southport Tramways Co. † Lg. & tr. station	127
1901	J. Lloyd	H. Bentham	8.17	4ft. 8½in.	87	20 d.d. (1 regen.) 1 s.d. (demi-car)	*	..	..	£85,031 inc. purch.	*	416,426	3,069,807	*Energy purchased from Southport Corporation & Birkdale Dist. Elec. Supply Co.	128
.	..	..	0.6	3ft. 6in.	..	3 s.d.	*	..	..	..	..	..	..	Third-rail system. *Energy supplied by Southport Corporation	129
1902	R. W. Cramp (Traffic)	G. Conaty (Eng. Man.)	14¾	3ft. 6in.	76 & 96	43 d.d.	273	190	..	..	..	1,018,003	7,782,261	Lines in W. Bromwich, Wednesbury, Dudley, Tipton, Handsworth, Doncaster	130
1904	..	R. Blackmore	25	4ft. 8½in.	99	35 d.d., 20 s.d.	1,500	1,000	750 A.H.	£255,708	£184,674	1,200,000	..	..	131
1899	William Hutchings	E. M. Hollingsworth	20½	4ft. 8½in.	97	36 d.d.	*	..	..	£123,153†	*	996,474	5,063,691	*Energy from St. H. Corpn. lg. & tr. station; see other Table. † Exc. cost of cars	132
1901	A. T. Eardley	A. J. H. Carter	15½	4ft. 8½in.	99	45 d.d.	1,548*	848	40 KW. for 6 hrs.	£134,963	£36,367	1,027,736	6,766,031	*Lg. & tr. station. Energy purchased from Electy. Dept. at 1½d. per unit	133
1900	A. R. Dayson	J. F. C. Snell, con. A. R. Dayson, res.	10⅞	4ft. 8½in.	96	52 d.d. 8 s.d. 4 comb.	1,600	742	..	£285,845	£28,521	1,508,879	16,103,842	..	134
1905	R. D. McCarter (gen. man. & eng.)	H. S. Watkins (res.)	13½	4ft. 8½in.	90	30 d.d.	*	..	..	..	*	..	..	*Power from Durham Collieries Elec. Pr. Co.	135
1901	H. Plews	A. W. Whieldon	5¾	5ft. 3in.	72	10 d.d. 1 s.d.	550	470	150 KW.	..	..	100,000	..	Feeder for Steam Line from Dublin to Howth. W. H. Mills, Ch. Eng.	136
1900	D. James	A. Johnston	12.43*	4ft. 8½in.	87-95	23 d.d. 30 s.d. 12 comb.	660†	420†	..	£244,276 inc. purch.	..	924,436	7,285,683	*7 miles leased fm. S. Corporation. †Energy for part of system from Corporation	137
1901	J. G. Griffin, g.m. T. Medcalf, t.m.	J. G. Griffin	3.7	3ft. 6in.	105	12 d.d.	900*	300 (tr.)	..	£41,446	*	232,000	2,992,012	*Lg. & tr. station	138

57	CATESHEAD, FELLINC AND WHICKHAM	Gateshead & Dist. Tramways Co.	1901	W. Morrison		11¼	4ft. 8½in.	90	25 d.d. 15 s.d., 10 comb.	..	..	..	..	..	1,266,325	11,285,769	57
58	CIANT'S CAUSEWAY & PORTRUSH	G. C. & P. Electric Tramway Co.	1883	D. Fall	W. A. Traill ..	8	3ft. 0in.	48	3 s.d., 19 tr.	100	90	..	£55,472	..	85,947	128,546	58
59	CLASCOW	Corporation	1898	J. Dalrymple ..	J. Ferguson ..	65¼	4ft. 7¾in.	109	660 d.d. 21 s.d.	11,200	7,500	..	£1,617,368	£956,892	14,008,750	117,179,547	59
60	CLOSSOP	Urban Electric Supply Co. ..	1903	C. E. Knowles ..	C. E. Knowles ..	4½	4ft. 8½in.	90	7 d.d., 1 s.d.	225	251	600 A.H.	£54,163	£48,037*	175,315	1,373,487	60
61	CLOUCESTER	Corporation	1904	Leonard Johnston	Leonard Johnston	9	3ft. 6in.	90	30 d.d. ..	1,150*	720	650 KW.	£146,876	£9,000*	563,595	3,902,077	61
62	COSPORT & FAREHAM ..	Provincial Tramways Co.*	1906 (Jan.)	J. Fereday Glenn	J. F. Glenn .. J. Glenn (Cons.)	6⅛	4ft. 7¾in.	95	18 d.d. (3 radial truck)	750	..	..	..	..	..	..	62
63	CRAVESEND, NORTHFLEET AND SWANSCOMBE	Gravesend and Northfleet Elec. Tramways	1902	A. W. Kipping..	A. W. Kipping..	6½	4ft. 8½in.	87	16 d.d. 2 s.d.	..	..	..	£120,128	..	358,284	3,193,961	63
64	CREENOCK AND PORT CLASCOW	Greenock & P. G. Tramway Co. ..	1901	F. Braidwood ..	A. R. Stirton ..	7¼	4ft. 7¾in.	92	30	..	..	..	..	..	633,464	8,437,882	64
65	CRIMSBY & CLEETHORPES	Grimsby Street Tramways Co. ..	1901	H. L. White (Res. Eng.)	S. Barnes ..	6	4ft. 8½in.	96	30 d.d., 6 trailers	300*	310	..	..	*	..	..	65
66	CUERNSEY	Guernsey Railway Co.	1892	A. L. Davis ..	A. L. Davis ..	3½	4ft. 8½in.	40, 74 & 84	9 d.d., 2 s.d. 8 trs.	100	50	..	£25,632 inclusive	..	167,079	922,759	66
67	HALIFAX	Corporation	1898	E. Spencer ..	W. M. Rogerson	37	3ft. 6in.	95	94 d.d., 2 s.d.	4,750*	2,712	1,100 A.H.	£388,763	£245,149*	1,680,967	19,366,230	67
68	HAMILTON, MOTHERWELL, WISHAW & LARKHALL	Lanarkshire Tramways Co. ..	1903	G. F. Moller ..	G. F. Moller ..	12.56	4ft. 7¼in.	96 & 101	40 d.d. ..	825	702	..	£207,757*	£52,857	1,018,553	8,344,556	68
69	HARTLEPOOL	Hartlepool Electric Tramways ..	1806	W. H. Bettison	W. H. Bettison	6.72	3ft. 6in.	90	22 d.d. ..	400	360	..	£33,137	..	451,000	3,188,796	69
70	HERNE BAY PIER	Herne Bay Pier Co.	..	.. ..	H. C. Dufton ..	¾	3ft. 0in.	..	3 s.d. ..	50	..	..	..	..	..	..	70
71	HEYWOOD	Heywood Corp. owner; Bury and Rochdale Corporations, lessees	1905	Jas. Stott ..	Jas. Stott ..	4.34	4ft. 8½in.	90	8 d.d. ..	520	260	..	£28,762	£6,496	*	*	71
72	HUDDERSFIELD	Corporation	1901	R. H. Wilkinson	R. H. Wilkinson	28	4ft. 7¾in.	98 & 105	70 d.d. ..	1,400	1,008	..	£414,250	..	1,750,650	13,993,449	72
73	HULL	Corporation	1899	W. J. McCombe	J. Wilkinson ..	13½	4ft. 8½in.	94	116 d.d. ..	1,560	1,250	..	£390,740		2,940,815	27,729,356	73
74	ILFORD	Urban District Council	1903	.. .. ..	A. H. Shaw ..	6⅜	4ft. 8½in.	100	22 d.d. (10 covered)		..		£192,874		614,951	6,271,173	74
75	ILKESTON	Corporation	1903	A. C. Gilbert ..	A. C. Gilbert ..	3.5	3ft. 6in.	90	13 d.d. ..	1,000	600	..	£45,780	..	188,396	1,543,772	75
76	IPSWICH	Corporation	1903	F. Ayton ..	F. Ayton ..	10.8	3ft. 6in.	90	36 d.d. ..	*	..	*	£113,804		653,617	5,255,373	76
77	ISLE OF MAN: (1) DOUGLAS-RAMSEY, (2) SNAEFELL MOUNTAIN	Manx Electric Railway Co.	(1893,'94, 1898, 1895	H. Brown ..	F. Edmondson.. (Res.)	18	3ft. 0in.	56 & 62½	37 mr., 44 tr.	1,300	1,250	300 KW.	..	..	398,692 (train miles)	501,696	77
	(3) DOUGLAS SOUTHERN	D. S. Electric Tramways	1896	F. W. Ketley ..	F. W. Ketley ..	4½ 3½	4ft. 8½in.	65	8	200	..	..	£41,445	..	32,504	192,031	
78	ISLE OF THANET	Isle of T. Elec. Trys. & Ltg. Co...	1901	R. Humphries ..	R. Humphries ..	11	3ft. 6in.	90	60 d.d. ..	1,000	1,000	125 KW.	..	..	1,500,000	7,000,000	78

129	SOUTH METROPOLITAN	South Metropolitan Electric Tramways & Lighting Co.	1903	Sir Geo. Gibbs (Gen. Man.)		12	4ft. 8½in.	90	40 d.d. ..	1,925*	1,050*	..	£152,277 (1905)	£117,286* (1905)	981,812	13,689,658 (1905)	*Lg. and tr. station	53	129
130	SOUTH STAFFORDSHIRE ..	South S. Tramways Co.	1902	H. Harrison .. G. Conaty (Man. & Eng.) H. Richardson		7	4ft. 8½in.	90	40 d.d. ..	1,000	1,000	500 KW.	£100,000	£50,000	1,000,000	5,000,000	Sunday running now adopted	54	130
131	STALYBRIDGE, HYDE DUKINFIELD & MOSSLEY	Stalybridge, Hyde Mossley Tramways Corporation; leases	1902			6	4ft. 8½in.	90	40 d.d. ..	1,000	1,000	500 KW.	£100,000	£50,000	1,000,000	5,000,000		55	131
132	ST. HELENS, PRESCOT & WIDNES	St. Helens Corporation	1898	J. Hamilton ..	J. Hamilton ..	12	4ft. 8½in.	90	40 d.d. ..	1,000	1,000	500 KW.	£100,000	£50,000	1,000,000	5,000,000		56	132
133	SUNDERLAND	Corporation	1905	R. D. McCarter (gen. man. & eng.) H. Plews ..		4	4ft. 8½in.	90	25 d.d. 15 s.d., 10 comb.	..	..	..	..	..	1,266,325	11,285,769		57	133
134	SUNDERLAND & DISTRICT	Sunderland & Dist. Elec. Tramways	1905			8	3ft. 0in.	48	3 s.d., 19 tr.	100	90	..	£55,472	..	85,947	128,546		58	134
135	SUTTON & HOWTH ..	Great Northern Ry. Co. (Ireland)	1901	D. James ..		4½	4ft. 8½in.	90	7 d.d., 1 s.d.	225	251	600 A.H.	£54,163	£48,037*	175,315	1,373,487		59	135
136	SWANSEA	Swansea Improvements & Try. Co.	1900	J. G. Griffin (gen.		1	3ft. 6in.	36	2 m.-cars, 1 trailer			tr. only	£25,000*	..	242,524	1,532,293		60	136
137	SWINDON	Corporation	1904			½	3ft. 6in.	36	2 m.-cars, 1 trailer			tr. only	£25,000*	..	242,524	1,532,293			137
138																			138

ELEC

	Name of Railway.	Districts Served.	Year of Opening.	Manager.	Electrical Engineer.	Consulting Engineers.	Length of Route in Miles.	Gauge.
1	BAKER ST. & WATERLOO RAILWAY	London: Elephant & Castle and Waterloo to Baker St. & Paddington	1906	.. ..	R. J. Chapman ..	Sir Ben. Baker; Galbraith & Church	5¼	4ft. 8½in.
2	BRIGHTON: VOLK'S ELECTRIC RAILWAY	Brighton	..	M. H. Volk	M. H. Volk	.. ..	1½ (single)	2ft. 8½in.
3	CENTRAL LONDON RAILWAY	London: Shepherd's Bush to Bank	1900	G. C. Cuningham ..	.. ..	Sir B. Baker, Basil Mott, H. F. Parshall	6½	4ft. 8½in.
4	CITY & SOUTH LONDON ELECTRIC RAILWAY	London: Angel, Islington, to Clapham Common..	1890	T. C. Jenkins	P. V. McMahon ..	J. H. Greathead, E. Hopkinson	6½	4ft. 8½in.
5	CREAT NORTHERN & CITY ELECTRIC RAILWAY	London: Finsbury Park to City	1904	R. P. Brousson ..	R. P. Brousson ..	Sir Douglas Fox & Partners	3.4	4ft. 8½in.
6	CREAT NORTHERN, PICCADILLY & BROMPTON RAILWAY ..	London: Finsbury Park to Hammersmith.. ..	Not open	.. ..	R. J. Chapman ..	.. ..	7½	4ft. 8½in.
7	CREAT WESTERN & HAMMERSMITH &C. RAILWAYS	London: Part of G. W. Ry. lines, also Bishop's Rd. to Hammersmith & Addison Rd.	Not open	J. C. Inglis (G.W.R.).. A. C. Ellis (Met. R.) ..	.. ..	Kennedy & Jenkin ..	4½	4ft. 8½in.
8	HAMMERSMITH & CITY RAILWAY	London: Hammersmith to City	Not open	.. ..	Roger T. Smith (G.W.R.)	.. ..	..	4ft. 8½in.
9	LANCASHIRE & YORKSHIRE RAILWAY	Liverpool, Southport & Crossens	1904 (converted)	John A. F. Aspinall (Gen. Man.)	Geo. Hughes (Chf. Mech. Eng.)	.. ..	27½	4ft. 8½in.
10	LIVERPOOL OVERHEAD RAILWAY	Liverpool Docks	1893	S. B. Cottrell	S. B. Cottrell	Sir Douglas Fox, J. H. Greathead	6½	4ft. 8½in.
11	LONDON, BRIGHTON & SOUTH COAST RAILWAY	South London: Victoria to London Bridge *via* Brixton	Not yet converted	William Forbes (Gen. Man.)	.. ..	Philip Dawson.. ..	11	4ft. 8½in.
12	MERSEY TUNNEL ELECTRIC RAILWAY	Birkenhead & Liverpool	1903 (converted)	R. Bowman Smith (Traffic Man.)	J. Shaw	.. ..	4.33	4ft. 8½in.
13	METROPOLITAN DISTRICT RAILWAY	London: Wimbledon, Hounslow, Uxbridge & Richmond to City, New Cross, East Ham, etc.	1905 (converted)	A. Collinson	J. R. Chapman.. ..	Chas. A. King, Eng. ..	24	4ft. 8½in.
14	METROPOLITAN RAILWAY	London: Baker St. to Uxbridge, & Inner Circle ..	1905 (converted)	A. C. Ellis (Gen. Man.)	Charles Jones	Thos. Parker	16¾	4ft. 8½in.
15	NORTH-EASTERN RAILWAY	Newcastle & Tynoside	1904 (converted)	R. E. Donnell (Secy.)	W. Worsdell	C. H. Merz	40	4ft. 8½in.
16	WATERLOO & CITY ELECTRIC RAILWAY	London: Waterloo Station & City (Mansion House)	1898	Sir C. J. Owens (Gen. Man.)	Herbert Jones	.. ..	3.15	4ft. 8½in.

ELECTRIC

	Name of Power Company	Districts served	Generating Stations	Year of Opening.	Engineer and Manager.	Consulting
1	CLEVELAND & DURHAM COUNTY ELECTRIC POWER CO.	N. Riding of Yorkshire and part of Durham County (820 sq. miles)	.. Eston Grange, Bishop Auckland & Consett (Lanchester, Witton Park, Hutton Henry, Haverton Hill, Aycliffe and Loftus)	1904	E. E. Soden (Gen. Man.)	Bramwell & H
2	CLYDE VALLEY ELECTRIC POWER CO.	Parts of Lanark, Renfrew, Dumbarton and Stirling (750 sq. miles)	.. Yoker and Motherwell	1905	David A. Starr	Strain & Robe
3	CORNWALL ELECTRIC POWER CO.	County of Cornwall	.. (St. Blazey and Philack)	..	.. ..	Maurice Georg
4	COUNTY OF DURHAM ELECTRIC POWER SUPPLY CO.	County of Durham (250 sq. miles	.. (Sunderland)			
5	DERBYSHIRE					

	A. T. Eardley ..	A. J. H. Carter..	15½	4ft. 8½in.	36	52 d.d. 8 s.d. 4 comb.	1,600	742	..	£285,845	£28,521	1,508,879	16,103,812												
	A. R. Dayson ..	J. F. C. Snell, con. A. R. Dayson, res.	10⅞	4ft. 8½in.	96	52 d.d. 8 s.d. 4 comb.	1,600	742	..	£285,845	£28,521	1,508,879	16,103,812												
	R. D. McCarter (gen. man. & eng.)	H. S. Watkins (res.)	13½	4ft. 8½in.	90	30 d.d. ..	..	..	..	..	..	..	..												
	H. Plews ..	A. W. Whieldon	5½	5ft. 3in.	72	10 d.d. 1 s.d.	550	470	150 KW.	..	..	100,000	..												
	D. James ..	A. Johnston ..	12.43*	4ft. 8½in.	87-95	23 d.d. 30 s.d. 12 comb.	660†	420†	..	£244,276 inc. purch. £11,446	..	924,436	7,285,683												
	J. G. Griffin, g.m.	J. G. Griffin	3.7	3ft. 6in.	105	12 d.d.	900*	200 (tr.)	..	..	..	232,000	2,992,012												

*Power from Durham Collieries Elec. Pr. Co. 135
Feeder for Steam Line from Dublin to Howth. W. H. Mills, Ch. Eng. 136
*7 miles leased fm. S. Corporation. †Energy for part of system from Corporation 137
*Lg. & tr. station 138

3 CORNWALL ELECTRIC POWER CO. .. .. County of Cornwall .. .. (St. Blazey and Phillack) .. .. Maurice Georgi ..

4 COUNTY OF DURHAM ELECTRIC POWER SUPPLY CO. .. .. County of Durham (250 sq. miles .. ..

.. Strain & Robertson ..	11,000, trains, to 400 x 220	*B. A.* 2,200 *C.* 2,300	25 ~, 3 ph. 25 ~, 2 ph. 25 ~, 3 ph.	*E. G.* 4,000 *B. A.* 450 *C.* 300 8,000	*B. A.* 242 KW., *C. & E. G.* just started.	..	2,452	534 H.P.	110 inc.	.. ..	Lg. 5′ to 4′: pr. 1½ to ¼	..	*B. A. & C.*, sl. scale; *E.G.*, flat rate of 5s. per H.P. per month & 0.45d. per unit					
.. Maurice Georgi						£100,000	.. ..

...of Durham County (820 sq. miles)	..	Eston Grange, Bishop Auckland & Consett (Lanchester, Witton Park, Hutton Henry, Haverton Hill, Ayecliffe and Loftus)	1904	E. E. Soden (Gen. Man.)	Bramwell & Harris	..	*E. G.* 11,000 *B. A.* 2,200 *C.* 2,200	25~, 3 ph. 25~, 3 ph. 50~, 2 ph.	*E.G.* 4,000 *B.A.* 450 *C.* 300	*B. A.* 242 kW., *C. & E. G.* just started.	..	2,452		
Dumbarton and Stirling (750 sq. miles	..	Yoker and Motherwell	1905	David A. Starr	Strain & Robertson	..	11,000, trans. to 400 x 270	25~, 3 ph.	8,000		£100,000			
		(St. Blazey and Phillack)			Maurice Georgi						£150,000			

	Name of Railway.	Districts Served.	Year of Opening.	Manager.	Electrical Engineer.	Consulting Engineers.	Length of Route in Miles.	Gauge.	Weight of Rail: Running.
1	**BAKER ST. & WATERLOO RAILWAY**	London: Elephant & Castle and Waterloo to Baker St. & Paddington	1906	..	R. J. Chapman ..	Sir Ben. Baker; Galbraith & Church	5½	4ft. 8½in.	..
2	**BRICHTON: VOLK'S ELECTRIC RAILWAY**	Brighton	..	M. H. Volk ..	M. H. Volk ..	..	1¾ (single)	2ft. 8½in.	35 lb.
3	**CENTRAL LONDON RAILWAY**	London: Shepherd's Bush to Bank	1900	G. C. Cuningham ..	..	Sir B. Baker, Basil Mott, H. F. Parshall	6½	4ft. 8½in.	100 lb.
4	**CITY & SOUTH LONDON ELECTRIC RAILWAY**	London: Angel, Islington, to Clapham Common	1890	T. C. Jenkins ..	P. V. McMahon ..	J. H. Greathead, E. Hopkinson	6¼	4ft. 8½in.	60 lb. & 80 lb.
5	**CREAT NORTHERN & CITY ELECTRIC RAILWAY**	London: Finsbury Park to City	1904	R. P. Brousson ..	R. P. Brousson ..	Sir Douglas Fox & Partners	3.4	4ft. 8½in.	80 lb.
6	**CREAT NORTHERN, PICCADILLY & BROMPTON RAILWAY**	London: Finsbury Park to Hammersmith	Not open	..	R. J. Chapman ..	..	7¼	4ft. 8½in.	..
7	**CREAT WESTERN & HAMMERSMITH &C. RAILWAYS**	London: Part of G. W. Ry. lines, also Bishop's Rd. to Hammersmith & Addison Rd.	Not open	J. C. Inglis (G.W.R.).. A. C. Ellis (Met. R.) ..	..	Kennedy & Jenkin ..	4¼	4ft. 8½in.	97½ lb.
8	**HAMMERSMITH & CITY RAILWAY**	London: Hammersmith to City	Not open	..	Roger T. Smith (G.W.R.)	..	..	4ft. 8½in.	..
9	**LANCASHIRE & YORKSHIRE RAILWAY**	Liverpool, Southport & Crossens	1904 (converted)	John A. F. Aspinall (Gen. Man.)	Geo. Hughes (Chf. Mech. Eng.)	..	27½	4ft. 8½in.	..
10	**LIVERPOOL OVERHEAD RAILWAY**	Liverpool Docks	1893	S. B. Cottrell ..	S. B. Cottrell ..	Sir Douglas Fox, J. H. Greathead	6½	4ft. 8½in.	60 lb.
11	**LONDON, BRICHTON & SOUTH COAST RAILWAY**	South London: Victoria to London Bridge via Brixton	Not yet converted	William Forbes (Gen. Man.)	..	Philip Dawson ..	11	4ft. 8½in.	..
12	**MERSEY TUNNEL ELECTRIC RAILWAY**	Birkenhead & Liverpool	1903 (converted)	R. Bowman Smith (Traffic Man.)	J. Shaw ..	..	4.33	4ft. 8½in.	86 lb.
13	**METROPOLITAN DISTRICT RAILWAY**	London: Wimbledon, Hounslow, Uxbridge & Richmond to City, New Cross, East Ham, etc.	1905 (converted)	A. Collinson ..	J. R. Chapman ..	Chas. A. King, Eng.	24	4ft. 8½in.	..
14	**METROPOLITAN RAILWAY**	London: Baker St. to Uxbridge, & Inner Circle	1905 (converted)	A. C. Ellis (Gen. Man.)	Charles Jones ..	Thos. Parker ..	19¾	4ft. 8½in.	..
15	**NORTH-EASTERN RAILWAY**	Newcastle & Tynemile	1904 (converted)	R. E. Dunnell (Sec.)	W. Worsdell ..	C. H. Merz ..	40	4ft. 8½in.	..
16	**WATERLOO & CITY ELECTRIC RAILWAY**	London: Waterloo Station & City (Mansion House)	1898	Sir C. J. Owens (Gen. Man.)	Herbert Jones ..	..	3.15	4ft. 8½in.	87 lb.

ELECTRIC

	Name of Power Company	Districts served	Generating Stations	Year of Opening	Engineer and Manager.	Consulting Engineers.
1	**CLEVELAND & DURHAM COUNTY ELECTRIC POWER CO.**	N. Riding of Yorkshire and part of Durham County (820 sq. miles)	Eston Grange, Bishop Auckland & Consett (Lanchester, Witton Park, Hutton Henry, Haverton Hill, Ayecliffe and Loftus)	1904	E. E. Soden (Gen. Man.)	Bramwell & Harris
2	**CLYDE VALLEY ELECTRIC POWER CO.**	Parts of Lanark, Renfrew, Dumbarton and Stirling (750 sq. miles	Yoker and Motherwell	1905	David A. Starr ..	Strain & Robertson
3	**CORNWALL ELECTRIC POWER CO.**	County of Cornwall	(St. Blazey and Phillack)			Maurice Georgi
4	**COUNTY OF DURHAM ELECTRIC POWER SUPPLY CO.**	County of Durham (250 sq. miles	Gateshead		A. S. Esclemont (Man.)	
5	**DERBYSHIRE & NOTTINCHAMSHIRE ELECTRIC POWER CO.**	County of Nottingham and part of the County of Derby 1,570 sq. miles	Ilkeston, Newark and Sutton-in-Ashfield	1903	A. E. Lees (Gen. Man.)	Bramwell & Harris
6	**FIFE ELECTRIC POWER CO.**	County of Fife	Townhill	1905	J. S. Thomson (Gen. Man.)	Bramwell & Harris
7	**CLOUCESTERSHIRE ELECTRIC POWER CO.**	County of Gloucester	Strand Land West Dean			G. L. Addenbrooke
8	**KENT ELECTRIC POWER CO.**	County of Kent, except Isle of Thanet	Friendsbury (Strood, Ilham, Dover & Tonbridge)		H. E. M. Kensit (Gen. Man.)	G. L. Addenbrooke, A. A. C. Swinton
9	**LANCASHIRE ELECTRIC POWER CO.**	Lancashire south of the Ribble, excluding Manchester, Salford, Stockport, part of Bolton, Liverpool and Bootle	Radcliffe	1905	R. Lorraine Gamlen ..	H. F. Parshall; Lacey, Sillar & Leigh
10	**LEICESTERSHIRE & WARWICKSHIRE ELECTRIC POWER CO.**	Counties of Leicester and Warwick (1,340 sq. miles)	(Newbold-on-Avon, Whitacre, Hinkley, Glenfield and Measham)			Bramwell & Harris
11	**MIDLAND ELECTRIC CORPORATION FOR POWER DISTRIBUTION**	Amblecote, Brettle Lane, Brierley Hill, Bilston, Compton, Cradley Heath, Darlaston, Finchfield, Kingswinford, Lye, Old Hill, Ocker Hill, Penn, Princes End, Pensnett, Quarry Bank, Tipton, Tettenhall, Willenhall, Wordsley and Wednesbury (70 sq. miles),	Ocker Hill, Tipton	1902	J. Hardie McLean ..	Kincaid, Waller, Manville & Dawson
12	**NEWCASTLE-UPON-TYNE ELECTRIC SUPPLY CO.**	Part of Northumberland (370 sq. miles)	Neptune Bank and Carville	1890	R. P. Sloan (Man.), J. S. Watson (Tech. Man.	C. H. Merz ..
13	**NORTH METROPOLITAN ELECTRIC POWER SUPPLY CO.**	Counties of Middlesex, Hertford & Essex (325 sq. miles); also London (Stoke Newington)	Brimsdown	1904	H. H. Perry (Res.) ..	A. H. Pott
			Willesden	1903	F. D. Napier (Res.) ..	E. Ruthven-Murray (Chief Eng.)
			Hertford	1901	J. M. Bowman (Res.) ..	E. Ruthven-Murray
14	**NORTH-WESTERN ELECTRICITY & POWER CAS CO.**	County of Cheshire, and parts of Stafford, Derby, Flint and Denbigh (2,000 sq. miles).	(Stone, Macclesfield, Sutton and Roxbourne)		J. Sturgeon ..	Lacey, Sillar & Leigh; H. A. Humphrey
15	**SCOTTISH CENTRAL ELECTRIC POWER CO.**	Linlithgow, Clackmannan, parts of Stirling and Dumbarton (400 sq. miles)	Bonnybridge	1905	E. C. Churchward (Gen. Man.), W. D. Morgan (Chief Eng.)	Bramwell & Harris
16	**SHANNON WATER & ELECTRIC POWER CO.**	Parts of Counties of Limerick and Clare	Clonlara			W. Barrington
17	**SOUTH WALES ELECTRICAL POWER DISTRIBUTION CO.**	Glamorganshire and part of Monmouth (1,034 sq. miles)	Pontypridd, Bridgend, Neath, Cwmbran	1904 1903 1905 1904	W. A. Chamen ..	Bramwell & Harris
18	**YORKSHIRE ELECTRIC POWER CO.**	Yorkshire (West Riding) 1,800 sq. miles	Thornhill (Bungley, Methley, Wath)	1905	W. B. Woolhouse ..	H. F. Parshall

WESTERN ELECTRIC COMPANY.

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D. SANTONI & CO., LTD.,
THE ALBA WORKS,

The **Westinghouse**

Opening.	Manager.	Electrical Engineer.	Consulting Engineers.	Length in Miles.	Running.	Conductor.	Kilowatts.	Recorded.	Battery.

	2,452		534 H.P.		110 inc.	.. ..	.. ..	Lg. 5½ to 4 : pr. 1¼ to ¼	.. ..	*B. L. & C.*, sl. scale: *M.G.*, flat rate 6*s.* per H.P. per month & 0·45*d.* per unit	270,980	First year's wkg. not yet completed. Eaton Grange in course of erection.	1
.. ..

COMPANY.

BRANTON & CO., LTD.,
THE ALBA WORKS,

Westinghouse

	Year of Opening.	Manager.	Electrical Engineer.	Consulting Engineers.	Length in Miles.	Gauge.	Weight of Rails per Yard. Running.	Conductor.	Cars.	Motors per Car.	Voltage.	Power Station Plant. Kilowatts.	Power recorded.	Battery.	Locomotives.
Baker	1906	.. ..	R. J. Chapman ..	Sir Ben. Baker; Galbraith & Church	5½	4ft. 8½in.	..	..	.. .. ..	..	600 v. D.C. ..	11,000 v. 33.3~, 3-ph.	..	..	.. .. ..
.. ..	..	M. H. Volk	M. H. Volk .. .	.. ..	1½ (single)	2ft. 8½in.	35 lb.	..	8	..	160 v. D.C. ..	160 v. D.C. ..	15 KW. (D.C. transformer)	..	120 A H. .. ..
..	1900	G. C. Cuningham ..	.. . .	Sir B. Baker, Basil Mott, H. F. Parshall	6½	4ft. 8½in.	100 lb	..	.. .. ..	..	500 v. D.C. ..	5,000 v. 25~, 3-ph.	5,100	..	.. .. ..
..m ..	1900	J. C. Jenkins	P. V. McMahon ..	J. H. Greathead, E. Hopkinson	6½	4ft. 8½in.	60 lb. & 80 lb.	..	52 locos.	..	500 v. D.C. ..	500, 1,000 & 2,000 v. D.C.	3,200	..	.. £2,754.
.. ..	1904	R. P. Brousson ..	R. P. Brousson ..	Sir Douglas Fox & Partners	3.4	4ft. 8½in.	80 lb.	80 lb.	26	32	550 v. D.C. ..	575 v. D.C. ..	3,440	..	.. £2,010.
.. ..	Not open	.. ..	R. J. Chapman ..	.. ..	7½	4ft. 8½in.	..	..	.. .. ..	..	600 v. D.C. ..	11,000 v. 33.3~, 3-ph.	.. .. ..	..	.. .. ..
hop's R.I.	Not open	J. C. Inglis (G.W.R.) .. A. C. Ellis (Met. Ry.) ..	.. ..	Kennedy & Jenkin ..	4½	4ft. 8½in.	97½ lb.	102 lb.	20	40	650 v. D.C. ..	6,000 v. 50~, 3-ph.	.. .. ..	..	.. .. ..
.. ..	Not open	.. ..	Roger T. Smith (G.W.R.)	.. ..	..	4ft. 8½in.	..	..	.. .. ..	..	..	.. .. ..	.. .. ..	..	.. .. ..
.. ..	1904 (converted)	John A. F. Aspinall (Gen. Man.)	Geo. Hughes (Chf. Mech. Eng.)	.. ..	27½	4ft. 8½in.	..	70 lb.	38	46	600 v. D.C. ..	7,500 v. 25~, 3-ph.	6,750	..	.. .. ..
.. ..	1884	S. B. Cottrell	S. B. Cottrell	Sir Douglas Fox, J. H. Greathead	6½	4ft. 8½in.	60 lb.	..	41	7	500 v. D.C. ..	500—550 v. D.C.	2,300	..	650 KW.
ridge ction	Not yet converted	William Forbes (Gen. Man.)	.. . .	Philip Dawson	11	4ft. 8½in.	..	..	8 trains	..	6,000 v. A.C.	6,000 v. 1-ph.	.. .. ..	..	.. .. ..
.. ..	1903 (converted)	R. Bruce Smith (Traffic Man.)	J. Shaw	.. ..	4.33	4ft. 8½in.	86 lb.	.	24	32	600 v. D.C. ..	630 v. D.C. ..	4,000	3,500	650 KW. £3,550,2
ridge A ion, etc.	1905 (converted)	A. Collinson	J. R. Chapman	Chas. A. King, Eng. ..	24	4ft. 8½in.	..	..	1.98	234	600 v. D.C. ..	11,000 v. 33.3~, 3-ph.	44,000	..	.. £11,770
Circle ..	1905 (converted)	A. C. Ellis (Gen. Man.)	Charles Jones	Thos. Parker	16¾	4ft. 8½in.	..	100 lb.	.. ..	..	600 v. D.C. ..	11,000 v. 40~, 3-ph.	14,000	5,000	.. £14,273.
.. ..	1901 (converted)	R. F. Dimmell (Sec.)	W. Worsdell	C. H. Merz	40	4ft. 8½in.	..	..	50*	30	600 v. D.C. ..	6,000 v. 40~, 3-ph.	†	..	.. .. ..
..p Hanger	1898	Sir C. J. Owens (Gen. Man.)	Herbert Jones	.. ..	3.15	4ft. 8½in.	87 lb.	..	17	12	500 v. D.C. ..	500 - 550 v. D.C.	1,200	660	..

ELECTRIC POWER COM

	Operating Stations	Year of Opening	Engineer and Manager.	Consulting Engineers.	Station Pressure volts	Frequency and phase.	Power Station output, Kilowatts.	Maximum load recorded, Kilowatts.	Capital expended.	Private lighting connections, equiv. 8-c.p.	Private motors.
..ty Council (820 sq. miles) ..	Eston Grange, Bishop Auckland & Consett (Lanchester, Witton Park, Hutton Henry, Haverton Hill, Ayclitfe and Lottus)	1904	E. E. Soden (Gen. Man.)	Brameell & Harris ..	*E. G.* 11,500 *B. A.* 2,200 *C.* 2,200	25~, 3 ph. 25~, 3 ph. 50~, 2 ph.	*E.G.* 4,000 *B. A.* 450 *C.* 300	*B. A.* 282 KW., *C. & E. G.* just started.	..	2,452	534 H.P.
d Stirling (754 sq. miles) ..	Yoker and Motherwell	1905	David A. Stacy	Strain & Robertson ..	11,000, trans. to 400 & 230	25~, 3 ph.	8,000	.. .. ..	£100,020	.. .. ..	.. .. ..
.. .. ..	(St. Blazey and Pinlacs)	..	.. .. ..	Maurice Gough ..	.. .. ..	.. .. ..	.. .. ..	.. .. ..	£450,000 authorised	.. .. ..	.. .. ..
.. .. ..	Carnforth	..	A. S. Esclement (Man.) ..	.. .. ..	.. .. ..	.. .. ..	.. .. ..	.. .. ..	£500,000 authorised	.. .. ..	.. .. ..
..ty of Derby (1,573 sq. miles) ..	Ilkeston, Newark and Sutton-in-Ashfield	1903	A. E. Lees, Gen. Man. ..	Brameell & Harris ..	500-550 D.C., 11,000 A.C.	25~, 3 ph. & three	3,000	.. .. ..	..	.. .. ..	3,032 H.P.
.. .. ..	Townhill	1905	J. S. Thomson (Gen. Man.)	Brameell & Harris ..	440 A.C.	50~, 2 ph.	600	.. .. ..	..	.. .. ..	.. .. ..
.. .. ..	Strood and West Dean	..	.. ..	G. L. Addenbrooke ..	.. .. ..	.. .. ..	.. .. ..	.. .. ..	£250,000 authorised	.. .. ..	.. .. ..
.. .. ..	Folkestone, Strood, Hythe, Dover & Tonbridge	..	H. E. M. Kensit (Gen. Man.)	G. L. Addenbrooke, A. A. C. Swinton	11,000	50~, 3 ph.	2,500	.. .. ..	..	.. .. ..	.. .. ..
Manchester, Salford, Stockport, ..	Rochdale	1907	R. Lorraine Gamlen ..	H. F. Parshall; Lacey, Sillar & Leigh	10,000	50~, 3 ph.	6,000	1,200	£300,000	.. .. ..	.. .. ..
.. .. ..	(Newbold-on-Avon, Whitacre, Hinkley, Glenfield and Measham)	..	.. ..	Brameell & Harris ..	.. .. ..	.. .. ..	.. .. ..	.. .. ..	£750,000 authorised	.. .. ..	.. .. ..
..ston, Compton, Cracker Heath, ..ey, Old Hill, Ocker Hill, Penn, Tipton, Tettenhall, Wilkenhall,	Ocker Hill, Tipton	1902	J. Hardie McLean ..	Kincaid, Waller, Manville & Dawson	7,000	50~, 2 ph	.. .. ..	.. .. ..	..	.. .. ..	.. .. ..
.. .. ..	Neptune Bank and Carville	1899	R. P. Sloan (Man.), J. S. Watson (Tech. Man.	C. H. Merz	5,500	40~, 3 ph.	20,000	15,300	£1,192,442	230,590	.. .. ..
.. .. ..	Bermondsey	1904	H. H. Perry (Res.) ..	A. H. Pott	11,000	50~, 3-ph.	3,000	1,080	£195,852	.. .. ..	Bulk sub-stations, 440 KW.
32½ sq. miles) .. (incl. London	Willesden	1903	F. D. Napier (Res.) ..	E. Ruthven-Murray (Chief Eng.)	240 & 480 D.C.; 10,000 & 2,950 A.C. (bulk only)	Direct, & 50~, 3-ph.	4,400	1,135	£154,027	.. .. ..	.. .. ..
.. .. ..	Hertford	1901	J. M. Bowman (Res.) ..	E. Ruthven-Murray ..	230 & 460 D.C.	Direct	300	118.6	£17,489	.. .. ..	.. .. ..
ord, Derby, Flint and Denbigh,	Stone, Macclesfield, Sutton and Realton	.. ..	J. Sturgeon	Lacey, Sillar & Leigh; H. A. Humphrey	.. .. ..	.. .. ..	.. .. ..	.. .. ..	£1,500,000 authorised	.. .. ..	.. .. ..
ng and Dunraven (100 sq. miles)	Bonnybridge	1905	E. C. Churchward (Gen. Man.), W. D. Morgan (Chief Eng.)	Brameell & Harris ..	440	50~, 2 & 3 ph.	2,700	.. .. ..	£600,000 authorised	.. .. ..	.. .. ..
.. .. ..	Chambers	..	.. ..	W. Barrington	.. .. ..	.. .. ..	.. .. ..	.. .. ..	£360,000 authorised	.. .. ..	.. .. ..
..H sq. miles)	Pontypridd, Bridgend, Neath, Cwmbran	1904 1903 1905 1904	W. A. Channon	Brameell & Harris ..	*P.* 11,000. *B.* 3,000. *N.* 2,200, *C.* 2,200	*P.* 25~, 3-ph *B.* 60~, 2-ph. *N.* 50~, 2-ph. *C.* 25~, 3-ph.	5,700 440 510 480	.. .. ..	..	.. .. ..	.. .. ..
.. ..	Thornhill (Bingley, Methley, Wath)	1905	W. B. Woodhouse ..	H. F. Parshall	10,000, 2,000, 400 A.C., 500 D.C.	50~, 3-ph.	6,000	600	£243,948	.. .. ..	.. .. ..

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LONDON,
PRESTON & KILMARNOCK

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TUR

15	NORTH-EASTERN RAILWAY	Newcastle & Tyneside	1904 (converted)	G. E. Pollitt (Sec.) .	W. Worsdell	C. H. Merz	40	4ft. 8½in.	..	..	..
16	WATERLOO & CITY ELECTRIC RAILWAY	London: Waterloo Station & City (Mansion House)	1898	Sir C. J. Owens (Gen. Man.)	Herbert Jones	.. ..	3.15	4ft. 8½in.	87 lb.	..	..

DICK ... LONDON ... Ltd. ... — AND — CABLE ... Tramcar . . . EDITION 1906

Battery.	Initial Cost of Station.	Mileage.	Receipts per Annum.	Receipts.		
..	..	..	..	..	Separate tunnels. Rotary converter substations. *Energy supplied by the Underground Electric Railways Co. of London, Ltd., from Lot's Road, Chelsea	1
120 A.H.	..	..	..	..	Third-rail system. Energy supplied by Brighton Corporation	2
..	..	..	44,731,501	52%	Separate tunnels. Four rotary converter substations. Multiple-unit control, 7-car trains, 2½-minute service	3
..	£2,754,135 (inclusive)	1,086,331	17,270,074	46.3%	Separate tunnels. First electric railway. Energy transmitted to substations at 1,300 and 2,000 v. D.C.	4
..	£2,010,000 authorised	..	..	..	Separate tunnels. Two conductor rails, no feeders. Multiple-unit control. Worked by S. Pearson & Son, Ltd.	5
..	..	..	..	..	Controlled by the Underground Electric Railways Co. of London, Ltd.	6
..	..	..	..	..	Three motor-generator substations, two with batteries. Park Royal Power Station, built by G.W.R., will also supply power and light to stations and goods yards. Work in progress	
..	..	..	..	..		8
..	..	..	..	..	Third rail outside track; fourth rail between running rails (no collector on it). Direct multiple control. Four rotary converter substations, with batteries. Four-coach trains, 8 150-H.P. motors per train	9
650 KW.	£859,061	752,400	9,881,468	77.57%	The Company constructed the Seaforth and Gt. Crosby tramways; power transmitted from railway power station to tramway substation at 1,100 v. D.C. Works cost per unit generated, .3843d.	10
..	..	..	..	..	Single-phase A.C. motors; direct supply from power station to overhead conductor at 6,000 volts	11
650 KW.	£3,550,241 (inclusive)	830,078	11,000,000	..	Tunnel Railway under River Mersey, formerly worked by steam; opened 1886. Third rail outside, return rail between running rails	12
..	£11,770,983 (inclusive)	.. ..	52,961,945 (part steam)	63.14%	Converted from steam. Turbine power station, 11 rotary converter substations. Multiple-unit control. Third and fourth conductor rails. *Also joint owners of 4 miles, running powers over 19 miles, in addition	13
..	£14,273,724 (inclusive)	785,386	95,694,616 (part steam)	48.79%	Turbine power station. Third and fourth rails, outside running rails. Multiple-unit control. Rotary converter substations. Total mileage worked over, 97½ miles (including steam)	14
..	..	1,196,392: car-miles 8,681,785	.. .. ..	..	Rotary converter substations. Multiple-unit control. Energy used 1905, 8,589,091 units. *Also 2 locos. for goods traffic. †Power supplied by Newcastle-on-Tyne Electric Supply Co. from Carville, turbine power station	15
..	£606,551	185,500	5,503,412	45%	Separate tunnels. Third rail between track rails. Line worked by L. & S.-W. Ry. Co.	16

OMPANIES.

ting H.P.	Private motors.	Public lighting connections.	Traction motors.	Total connections of all kinds, equiv. 8-c.p.	Price charged per unit, power		System of charging.	Units sold during last complete year.	Remarks.	
	534 H.P.	110 inc.	.. .. ..	.. .. ..	Lg. 5½ to 4: pr. 1½ to ½	.. ..	*B. L. & C., sl. scale; E.G., flat rate or 5s. per H.P. per month & 0.45d. per unit	279,880	First year's wkg. not yet completed. Luston Grange in course of erection. Address: 1, Hin ons' Buildings, Middlesbrough. Sec., P. Greenough	1
..	..	..	..	..	..	..	Max. demand	.. .. ..	Yoker started August, 1905, and Motherwell January, 1906. Address: 53, Bothwell St., Glasgow. Sec., James Mackenzie	2
..	..	..	..	..	..	..	..	.. .. ..	Supply not commenced. Sec., John A. Stoneham, 89 & 90, Cheapside, E.C.	3
..	..	..	..	..	..	..	..	.. .. ..	Supplied in bulk by Newcastle-upon-Tyne Electric Supply Co. Sec., A. B. Gridley, Royal Exchange Buildings, Newcastle-upon-Tyne	4
..	3,032 H.P.	..	..	..	..	..	Max. demand & sl. scale	.. .. ..	Offices: Queen's Chambers, King Street, Nottingham. Sec., W. W. Simpson	5
..	..	..	..	..	..	..	..	.. .. ..	First year incomplete; statistics not yet available	6
..	..	..	..	..	..	..	..	.. .. ..	Supply not commenced. Sec., J. French, 5, Rowcroft, Stroud, Glos.	7
..	..	..	..	..	..	..	..	.. .. ..	Chatham works burnt down; supply from Gillingham Corp. Frindsbury power station in course of erection. Sec., F. A. H. Walker, 7, St. Helen's Place, E.C.	8
..	..	..	..	2,000 H.P.	From 0.65 to 4	.. ..	Various	First year incomplete	Conditions changing so rapidly that figures cannot be given; connections may be increased by large amounts in a very short time. Office, 136, Deansgate, Manchester	9
..	..	..	..	..	..	..	..	.. .. ..	Registered offices: 5, Great George Street, S.W.	10
..	..	..	..	..	Lg. 6 & 8, or 4½; pr. 3 & 0.825, or 1½	..	Max. demand & flat rate	.. .. ..	Sec., G. Sales, 75, Lichfield St., Wolverhampton	11
..	..	1,094 eq. 8-c.p.	1,123,668 eq. 8-c.p. (pr., tr. & bulk supply)	1,325,452	Lg. 3½ pb. lg. £2 15s. 6d. per 16-c.p. p.a.; pr. 1½ w. dis		Flat rate	30,378,852	Sec., M. Short, Royal Exchange Bldgs., Newcastle-upon-Tyne. Battery, max. discharge 1,050 KW.	12
..	Bulk sub-stations, 440 KW.	Car shed, 15 arc, 723 inc.	254 – 7,100 H.P.	.. .. ..	Tr. 1.1	.. ..	.. .. ..	3,161,245 (1905)	Supply to Met. Elec. Trys.; bulk supply to Barnet and Stoke Newington sub-stations	13
..	..	..	..	..	..	..	Contract on max. dem. & flat rate	1,894,346	Bulk supply to Willesden U.D.C.; supply to Met. Elec. Trys., Middlesex C.C. Lt. Rys., Harrow Road & Paddington Trys.	
..	..	..	..	8,003	£1 per KW. of max. dem., & 0.9d. to 0.4d. per unit		Max. demand & scale	141,925	Bulk supply to North Metropolitan Elec. Pr. Distribution Co.	
..	..	..	..	..	..	..	..	.. .. ..	Sec., R. Fleming, 37, Cross Street, Manchester	14
..	..	..	..	..	Pr. 1½ to ½; tr. contract	.. ..	Max. dem., sl. scale, 2-rate mtr. & cont.	.. .. ..	Operations commenced end of 1905; further data not yet available. Sec., Jas. Walker, Scotsman Buildings, 34, North Bridge, Edinburgh	15
..	..	..	..	..	..	..	..	.. .. ..	Sec., H. Klingner, 96, College Green, Dublin	16
..	..	..	..	..	2½ to ¾	.. ..	Sliding scale	.. .. ..	Sec., G. P. Tutcher, Royal Chambers, Queen St., Cardiff	17
..	..	..	..	1,040 KW.	£4 per KW. p.a. & 0.85d. to 0.35d. per unit		Max. demand	.. .. ..	Address: Central Bank Chambers, Leeds. Sec., J. J. H. Stansfeld	18

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The Electric Tramcar . . . Handbook . . THIRD EDITION, 1906.

HART Accumulator Co., Ltd..

..	..	..	50'	50	600 v. D.C. ...	6,900 v. 40~, 3-ph.	¾	..	..	..	..	1,196,392: car-miles 8,681,785	.. .. ..	Rotary converter substations. Multiple-unit control. Energy to Newcastle-on-Tyne Electric Supply Co. from Carville, turbine p
87 lb.	..	..	17	12	500 v. D.C. ...	500 - 550 v. D.C.	1,203	600	..	..	£606,551	185,500	5,503,412 45%	Separate tunnels. Third rail between track rails. Line worked by

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et,
TUR

Westinghouse
Magnetic Brake.

DICK
Ltd.
LONDON,
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15	NORTH-EASTERN RAILWAY	Newcastle & Tynside	1904 (converted)	C. F. Dolmetsch (Sec.)	W. Worsdell	C. H. Merz	40	4ft. 8½in.	
16	WATERLOO & CITY ELECTRIC RAILWAY	London: Waterloo Station & City (Mansion House)	1898	Sir C. J. Owens (Gen. Man.)	Herbert Jones		3.15	4ft. 8½in.	87 lb.

ELECTRIC

	Name of Power Company	Districts served	Generating Stations	Year of Opening.	Engineer and Manager.	Consulting Engineers.
1	CLEVELAND & DURHAM COUNTY ELECTRIC POWER CO.	N. Riding of Yorkshire and part of Durham County (820 sq. miles)	Eston Grange, Bishop Auckland & Consett (Lanchester, Witton Park, Hutton Henry, Haverton Hill, Ayeliffe and Lottus)	1904	E. E. Sedon (Gen. Man.)	Bramwell & Harris
2	CLYDE VALLEY ELECTRIC POWER CO.	Parts of Lanark, Renfrew, Dumbarton and Stirling (750 sq. miles	Yoker and Motherwell	1905	David A. Starr	Strain & Robertson
3	CORNWALL ELECTRIC POWER CO.	County of Cornwall	(St. Blazey and Phillack)			Maurice Georgi
4	COUNTY OF DURHAM ELECTRIC POWER SUPPLY CO.	County of Durham (250 sq. miles	Gateshead		A. S. Esslemont (Man.)	
5	DERBYSHIRE & NOTTINGHAMSHIRE ELECTRIC POWER CO.	County of Nottingham and part of the County of Derby (1,570 sq. miles)	Ilkeston (Newark and Sutton-in-Ashfield)	1903	A. E. Lees (Gen. Man.)	Bramwell & Harris
6	FIFE ELECTRIC POWER CO.	County of Fife	Townhill	1905	J. S. Thomson (Gen. Man.)	Bramwell & Harris
7	GLOUCESTERSHIRE ELECTRIC POWER CO.	County of Gloucester	Strand and West Dean			G. L. Addenbrooke
8	KENT ELECTRIC POWER CO.	County of Kent, except Isle of Thanet	Frindsbury (Strood, Bleau, Dover & Tonbridge)		H. R. M. Kensit (Gen. Man.)	G. L. Addenbrooke, A. A. C. Swinton
9	LANCASHIRE ELECTRIC POWER CO.	Lancashire south of the Ribble, excluding Manchester, Salford, Stockport, part of Bolton, Liverpool and Bootle	Radcliffe	1907	R. Lorraine Gamlen	H. F. Parshall; Lacey, Sillar & Leigh
10	LEICESTERSHIRE & WARWICKSHIRE ELECTRIC POWER CO.	Counties of Leicester and Warwick (1,340 sq. miles)	(Newbold-on-Avon, Whitacre, Hinkley, Glenfield and Measham)			Bramwell & Harris
11	MIDLAND ELECTRIC CORPORATION FOR POWER DISTRIBUTION	Ambleeote, Brettle Lane, Brierley Hill, Bilston, Compton, Cradley Heath, Darlaston, Finchfield, Kingswinford, Lye, Old Hill, Ocker Hill, Penn, Princes End, Pensnett, Quarry Bank, Tipton, Tettenhall, Wiltenhall, Wordsley and Wednesbury (70 sq. miles).	Ocker Hill, Tipton	1902	J. Hachie McLean	Kincaid, Waller, Manville & Dawson
12	NEWCASTLE-UPON-TYNE ELECTRIC SUPPLY CO.	Part of Northumberland (370 sq. miles)	Neptune Bank and Carville	1890	R. P. Sloan (Man.), J. S. Watson (Tech. Man.)	C. H. Merz
13	NORTH METROPOLITAN ELECTRIC POWER SUPPLY CO.	Counties of Middlesex, Hertford & Essex (325 sq. miles); also London (Stoke Newington)	Brimsdown	1904	H. H. Perry (Res.)	A. H. Pott
			Willesden	1903	F. D. Napier (Res.)	E. Ruthven-Murray (Chief Eng.)
			Hertford	1901	J. M. Bowman (Res.)	E. Ruthven-Murray
14	NORTH-WESTERN ELECTRICITY & POWER CAS CO.	County of Cheshire, and parts of Stafford, Derby, Flint and Denbigh (2,000 sq. miles).	(Stone, Macclesfield, Sutton and Roabon)		J. Sturgeon	Lacey, Sillar & Leigh; H. A. Humphrey
15	SCOTTISH CENTRAL ELECTRIC POWER CO.	Linlithgow, Clackmannan, parts of Stirling and Dumbarton (400 sq. miles)	Bonnybridge	1905	E. C. Churchward (Gen. Man.), W. D. Morgan (Chief Eng.)	Bramwell & Harris
16	SHANNON WATER & ELECTRIC POWER CO.	Parts of Counties of Limerick and Clare	Clonlara			W. Barrington
17	SOUTH WALES ELECTRICAL POWER DISTRIBUTION CO.	Glamorganshire and part of Monmouth (1,034 sq. miles)	Pontypridd, Bridgend, Neath, Cwmbran	1904, 1903, 1905, 1904	W. A. Chamen	Bramwell & Harris
18	YORKSHIRE ELECTRIC POWER CO.	Yorkshire (West Riding) 1,800 sq. miles	Thornhill (Bingley, Methley, Wath)	1905	W. B. Woodhouse	H. F. Parshall

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BIRMINGHAM: Central House, New Street.
BELFAST: 7, Donegal Square.
SOUTH AFRICA: Johannesburg, Consolidated Buildings.

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		(Gen. Man.)	Mech. Engr.)														
1834		S. B. Cottrell	S. B. Cottrell	Sir Douglas Fox, J. H. Greathead	6½	4ft. 8½in.	60 lb.	..	44	7	500 v. D.C.	500—550 v. D.C.	2,300	..	650 KW.		£85
	N.S.W. converted	William Forbes (Gen. Man.	..	Philip Dawson	11	4ft. 8½in.	..	..	8 trains	..	6,000 v. A.C.	6,000 v. 1-ph.	..	..	..	..	..
1903		R. Bosman Smith	J. Shaw		4.33	4ft. 8½in.	86 lb.	..	24	32	600 v. D.C.	650 v. D.C.	4,000	3,500	650 KW.		£3,550,241

CABLE
Manufacturers.

Handbook . .

1906.

Accumulator Co., Ltd..

⅝in.	..	..	50~	30	600 v. D.C. ..	6,000 v. 40~, 3-ph.	7	..	..	..	..	..	..	..	1,196,392 ; carriles 3,681,785	..	..	..	..	Rotary converter sub-stations. Multiple-unit control. Energy fr Newcastle-on-Tyne Electric Supply Co. from C'arville, for line g
8½in.	87 lb.	..	17	12	500 v. D.C. ..	500 - 550 v. D.C.	1,200	600	..	£606,551					185,500	5,503,412	45%	..	..	Separate tunnels. Third rail between track rails. Line work fully

POWER COMPANIES.

sulting Engineers.	Station Pressure volts	Frequency and phase.	Power Station output, Kilowatts.	Maximum load recorded, Kilowatts.	Capital expended.	Private lighting connections, equiv. 8-C.P.	Private motors.	Public lighting connections.	Traction motors.	Total connections of all kinds, equiv. 8-C.P.	Price charged per unit, private	System of charging.	Units
well & Harris ..	*E. G.* 11,500 *B. A.* 2,200 *C.* 2,200	25~, 3 ph. 25~, 3 ph. 50~, 2 ph.	*E.G.* 4,000 *B.A.* 450 *C.* 300	*B. A.* 282 KW., *C. & E. G.* just started.	..	2,452	534 H.P.	110 inc.	.. .. ..	.. .. ..	Lg. 5½ to 4 ; pr. 1½ to ¼	*B. C. & C.*, sliding scale; *E.G.*, flat rate of 5*s.* per H.P. per month & 0·45*d.* per unit	
n & Robertson ..	11,000, trans. to 400 & 230	25~, 3 ph.	8,000	.. .. ..	£400,000	.. ..						Max. demand	
ice Georgi	.. ..				£450,000 authorised	.. ..							
.. .. ..	.. ..				£500,000 authorised	.. ..							
well & Harris ..	500-550 D.C., 11,000 A.C.	25~, 3 ph. & Direct	3,000	.. .. ..	..	.. .. ..	3,032 H.P.	.. .. ..	.. .. ..	.. .. ..	.. .. ..	Max. demand & sl. scale	..
well & Harris ..	440 A.C.	50~, 2 ph.	600	.. .. ..	..	.. ..							
Addenbrooke's ..	.. ..				£250,000 authorised	.. ..							
Addenbrooke, A. C. Swinton	11,000	50~, 3 ph.	2,500	.. .. ..	..	.. ..							
Parshall; Lacey, ar & Leigh	10,000	50~, 3 ph.	6,000	1,200	£300,000	.. ..				2,000 H.P.	From 0·65 to 1	Various	First 1
well & Harris					£750,000 authorised	.. ..							
id, Waller, Man- & Dawson	7,000	50~, 2 ph	.. .. ..	.. .. ..	..	.. .. ..	.. .. ..	.. .. ..	.. .. ..	.. .. ..	Lg. 6 & 3, or 4½ ; pr. 3 & 0·825, or 1½	Max. demand & flat rate	..
Merz	5,500	40~, 3 ph.	20,000	15,300	£1,192,442	200,000	.. .. ..	1,094 eq. 8-C.P.	1,123,668 eq. 8-C.P. (pr., tr. & bulk supply)	1,325,452	Lg. 3½ ph. lg. £2 15*s.* 6*d.* per 10-C.P.	Flat rate	
Pott	11,000	50~, 3-ph.	3,000	1,980	£195,852	.. .. ..	Bulk sub-stations, 440 KW.	Car shed, 15 arc, 723 inc.	254–7,100 H.P.	.. .. ..	Tr. 1.1	.. .. ..	
thven-Murray (Chief)	240 & 480 D.C.; 10,000 & 2,950 A.C. (bulk only)	Direct, & 50~, 3-ph.	4,400	1,135	£154,027	.. ..						Contract: m max. dem. & flat rate	
thven-Murray ..	230 & 460 D.C.	Direct	300	118.6	£17,489	.. ..				8,003	£1 per KW. of max. dem., & 0·3*d.* to 0·4*d.* per unit	Max. demand & scale	..
, Sillar & Leigh; A. Humphrey	.. ..				£1,500,000 authorised	.. ..							
well & Harris ..	440	50~, 2 & 3 ph.	2,700	.. .. ..	£600,000 authorised	.. ..					Pr. 1½ to ¼ ; tr. contract	Max. dem., sl. scale, 2 rate mtr. & cont.	
rrington					£360,000 authorised	.. ..							
well & Harris ..	*P.* 11,000. *B.* 3,000. *N.* 2,200. *C.* 2,200	*P.* 25~, 3-ph. *B.* 60~, 2-ph. *N.* 50~, 2-ph. *C.* 25~, 3-ph.	5,700 440 510 990	.. .. ..	..	.. ..					2¼ to ¾	Sliding scale	..
Parshall	10,000, 2,000, 400 A.C., 500 D.C.	50~, 3-ph.	6,000	600	£345,948	.. ..				1,040 KW.	£1 per KW. p.a. & 0·85*d.* to 0·35*d.* per unit	Max. demand	.. ..

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£859,061	752,469	8,881,468	77.57%	The Company constructed the Seaforth and Gt. Crosby tramways; power transmitted from railway power station at Seaforth by [illegible]. Works cost per unit generated, .3813d.		
.. .. ..	.. .. ..	.. .. ..	..	Single-phase A.C. motors; direct supply from power station to overhead conductor at 6,000 volts	..	11
£3,550,241 (inclusive)	830,078	11,000,000	..	Tunnel Railway under River Mersey, formerly worked by steam; opened 1886. Third rail outside, return rail between, running rails		12
		59,081,945	63.14%	Converted from steam. Turbine power station, 11 rotary converter sub-stations. Multiple-unit control. Third and fourth conductor rails. *Also		13

		(Gen. Man.)	Mech. Engr.)															
	1884	S. B. Cottrell	S. B. Cottrell	Sir Douglas Fox, J. H. Greathead	6½	4ft. 8½in.	60 lb.	..	44	7	500 v. D.C. ..	500—550 v. D.C.	2,300	..	650 KW.		
	Not yet converted	William Forbes (Gen. Man.)	.. ..	Philip Dawson	11	4ft. 8½in.	..	..	8 trains	..	6,000 v. A.C.	6,000 v. 1-ph.	.. .. ..	..	..	.. ..	
	1903 converted	R. Bateman Smith (Traffic Man.)	J. Shaw	.. ..	4.33	4ft. 8½in.	86 lb.	..	24	32	600 v. D.C. ..	650 v. D.C. ..	4,000	3,500	650 KW.		£3,550,2
	1905 converted	A. Collinson	J. R. Chapman	Chas. A. King, Eng. ..	24	4ft. 8½in.	..	..	108	234	600 v. D.C ..	11,000 v. 33.3~, 3-ph.	44,600	..	..		£11,770
	1907 converted	A. C. Ellis (Gen. Man.)	Charles Jones	Thos. Parker	16¾	4ft. 8½in.	..	100 lb.	.. ..	..	600 v. D.C. ..	11,000 v. 40~, 3-ph.	14,000	5,000	..		£14,273
	1901 converted	R. F. Dennell (Sec.)	W. Worsdell	C. H. Merz	40	4ft. 8½in.	..	..	50*	30	600 v. D.C. ..	6,000 v. 40~, 3-ph.	7	..	..	..	
	1904	Sir C. J. Gibson (Gen. Man.)	Herbert Jones	.. ..	3.15	4ft. 8½in.	87 lb.	..	17	12	500 v. D.C. ..	500 - 550 v. D.C.	1,200	600	..		

ELECTRIC POWER COMP

	Generating Stations	Year of Opening	Engineer and Manager.	Consulting Engineers.	Station Pressure, volts	Frequency and phase.	Power Station output, Kilowatts.	Maximum load recorded, Kilowatts.	Capital expended.	Private lighting connections, equiv. 8-c.p.	Private motors.
	Eston Grange, Bishop Auckland & Consett (Lanchester, Witton Park, Hutton Henry, Haverton Hill, Ayclitfe and Lattus)	1904	E. E. Soden (Gen. Man.)	Bramwell & Harris ..	*E. G.* 11,000 *B. A.* 2,200 *C.* 2,200	25~, 3 ph. 25~, 3 ph. 70~, 2 ph.	*E.G.* 4,000 *B.A.* 450 *C.* 300	*B. A.* 242 KW., *C. & E. G.* just started.	..	2,452	534 H.P.
	Yeiler and Motherwell	1907	David A. Stare	Strain & Robertson ..	11,000, trans. to 400 & 230	25~, 3 ph.	8,000	.. .. ..	£400,000	.. .. ..	.. .. ..
	St. Bees and Pinfarth	..	.. ..	Maurice Georgi	.. .. ..	.. .. ..	.. .. ..	.. .. ..	£450,000 authorised	.. .. ..	.. .. ..
	Consett	..	A. S. Eschemont (Man.) ..	.. ..	.. .. ..	.. .. ..	.. .. ..	.. .. ..	£500,000 authorised	.. .. ..	.. .. ..
	Ilkeston, Newark and Sutton-in-Ashfield	1903	A. E. Lees (Gen. Man.) ..	Bramwell & Harris ..	500-550 D.C., 11,000 A.C.	25~, 3 ph. & direct	3,000	.. .. ..	..	.. .. ..	3,032 H.P.
	Dawdon	1905	J. S. Thomson (Gen. Man.)	Bramwell & Harris ..	440 A.C.	50~, 2 ph.	600	.. .. ..	..	.. .. ..	.. .. ..
	Stroud and West Drayton	..	.. ..	G. L. Addenbrooke ..	.. .. ..	.. .. ..	.. .. ..	.. .. ..	£250,000 authorised	.. .. ..	.. .. ..
	Pembury, Strood, Brean, Dover & Tonbridge	..	H. E. M. Kensit (Gen. Man.)	G. L. Addenbrooke, A. A. C. Swinton	11,000	50~, 3 ph.	2,500	.. .. ..	..	.. .. ..	.. .. ..
	Bollin	1907	R. Lucas-Gamlen ..	H. F. Parshall; Lacey, Sillar & Leigh	10,000	50~, 3 ph.	6,000	1,200	£300,000	.. .. ..	.. .. ..
	Nuneaton, Atherstone, Whitacre, Hinkley, Glenfield and Measham	..	.. ..	Bramwell & Harris ..	.. .. ..	.. .. ..	.. .. ..	.. .. ..	£750,000 authorised	.. .. ..	.. .. ..
	Tinker Hill, Upton	1902	J. Hachie McLean ..	Kincaid, Waller, Manville & Dawson	7,000	50~, 2 ph	.. .. ..	.. .. ..	..	.. .. ..	.. .. ..
	Neptune Bank and Carville	1900	R. P. Sloan (Man.), J. S. Watson (Tech. Man.	C. H. Merz	5,500	40~, 3 ph.	20,000	15,400	£1,192,442	200,540	.. .. ..
	Bonnybridge	1904	H. H. Perry (Res.) ..	A. H. Pott	11,000	50~, 3-ph.	3,000	1,980	£195,852	.. .. ..	Bulk sub-stations, 440 KW.
	Willesden	1903	F. D. Napier (Res.) ..	E. Ruthven-Murray Chief Eng.)	240 & 480 D.C.; 10,000 & 2,950 A.C. (bulk only)	Direct. & 50~, 3-ph.	4,400	1,135	£154,027	.. .. ..	.. .. ..
	Hertford	1901	J. M. Bowman (Res.) ..	E. Ruthven-Murray ..	230 & 460 D.C.	Direct	300	118.6	£17,489	.. .. ..	.. .. ..
	Stone, Macclesfield, Sutton and Reabon	..	J. Sturgeon	Lacey, Sillar & Leigh; H. A. Humphrey	.. .. ..	.. .. ..	.. .. ..	.. .. ..	£1,500,000 authorised	.. .. ..	.. .. ..
	Bonnybridge	1905	E. C. Churchward (Gen. Man.), W. D. Morgan (Chief Eng.)	Bramwell & Harris ..	440	50~, 2 & 3 ph.	3,700	.. .. ..	£600,000 authorised	.. .. ..	.. .. ..
	Cumbria	..	.. ..	W. Barrington	.. .. ..	.. .. ..	.. .. ..	.. .. ..	£360,000 authorised	.. .. ..	.. .. ..
	Pontypool, Bridgend, Neath, Cwmbran	1904 1903 1905 1904	W. A. Chanon	Bramwell & Harris ..	*P.* 11,000 *B.* 3,000, *N.* 2,200, *C.* 2,200	*P.* 25~, 3-ph *B.* 60~, 2-ph. *N.*50~, 2-ph. *C.*25~, 3-ph.	5,700 440 510 990	.. .. ..	..	.. .. ..	.. .. ..
	Dewsbury, Batley, Morley, Wath	1905	W. B. Woodhouse ..	H. F. Parshall	10,000, 2,000, 400 A.C., 500 D.C.	50~, 3-ph.	6,000	660	£245,948	.. .. ..	.. .. ..

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w.	£859,061	752,460	8,881,468	77.57%	The Company constructed the Seaforth and Gt. Crosby tramways; Power transmitted from railway power station at Crosby [illegible] Works cost per unit generated, .3813d.	10
.. ..	.. ..	.. ..	.. ..		Single-phase A.C. motors; direct supply from power station to overhead conductor at 6,000 volts	11
kw.	£3,550,241 (inclusive)	830,078	11,000,000	..	Tunnel Railway under River Mersey, formerly worked by steam (opened 1886). Third rail outside, return rail between, running rails	12
.	£11,770,983 (inclusive)	.. ..	52,961,945 (part steam)	63.14%	Converted from steam. Turbine power station, 11 rotary converter sub-stations. Multiple-unit control. Third and fourth conductor rails. *Also joint owners of 4 miles, running powers over 19 miles, in addition	13
.	£14,273,724 (inclusive)	785,586	95,694,616 (part steam)	48.79%	Turbine power station. Third and fourth rails, outside running rails. Multiple-unit control. Rotary converter sub-stations. Total mileage worked over, 87½ miles (including steam)	14
. .. .	.. ..	1,196,392; car-miles 3,681,785	.. ..		Rotary converter sub-stations. Multiple-unit control. Energy used 1905, 8,589,991 units. *Also 2 locos. for goods traffic. †Power supplied by Newcastle-on-Tyne Electric Supply Co. from Carville, turbine power station	15
.	£606,551	185,500	5,503,412	45%	Separate tunnels. Third rail between track rails. Line worked by L. & S.-W. Ry. Co.	16

MPANIES.

Private motors.	Public lighting connections.	Traction motors.	Total connections of all kinds, equiv. 8-c.p.	Price charged per unit, pence.	System of charging.	Units sold during last complete year.	Remarks.	
534 H.P.	110 inc.	.. .. ..	.. .. ..	Lg. 5½ to 4; pr. 1½ to ½	*B. I. & C.*, sl. scale; *E.G.*, flat rate or 5s. per H.P. per month & 0·45d. per unit	270,880	First year's wkg. not yet completed. Eston Grange in course of erection. Address: 1, Hinchons' Buildings, Middlesbrough. Sec., P. Greenough	1
.. ..	.. ..	.. ..	.. ..	.. ..	Max. demand		Yoker started August, 1905, and Motherwell January, 1906. Address: 53, Bothwell St., Glasgow. Sec., James Mackenzie	2
.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. .. ..	Supply not commenced. Sec., John A. Stoneham, 89 & 90, Cheapside, E.C.	3
.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. .. ..	Supplied in bulk by Newcastle-upon-Tyne Electric Supply Co. Sec., A. B. Gridley, Royal Exchange Buildings, Newcastle-upon-Tyne	4
3,032 H.P.	.. ..	.. ..	.. ..	.. ..	Max. demand & sl. scale	.. .. ..	Offices: Queen's Chambers, King Street, Nottingham. Sec., W. W. Simpson	5
.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. .. ..	First year incomplete; statistics not yet available	6
.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. .. ..	Supply not commenced. Sec., J. French, 5, Roweroft, Stroud, Glos. ..	7
.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. .. ..	Chatham works burnt down; supply from Gillingham Corp. Frindsbury power station in course of erection. Sec., F. A. H. Walker, 7, St. Helen's Place, E.C.	8
.. ..	.. ..	.. ..	2,000 H.P.	From 0·65 to 4	Various	First year incomplete	Conditions changing so rapidly that figures cannot be given; connections may be increased by large amounts in a very short time. Office, 196, Deansgate, Manchester	9
.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. .. ..	Registered offices: 5, Great George Street, S.W.	10
.. ..	.. ..	.. ..	.. ..	Lg. 6 & 3, or 4½; pr. 3 & 0·825, or 1½	Max. demand & flat rate		Secs., G. Sales, 79, Lichfield St., Wolverhampton	11
.. .. ..	1,094 eq. 8-c.p.	1,123,668 eq. 8-c.p. (pr., tr. & bulk supply) 254 – 7,100 H.P.	1,325,452	Lg. 3½; pb. lg. £2 15s. 6d. per 16-c.p. p.a.; pr. 1½ w.-dis	Flat rate	30,378,852	Secs., M. Short, Royal Exchange Bldgs., Newcastle-upon-Tyne. Battery, max. discharge 1,050 KW.	12
Bulk sub-stations, 440 KW.	Car shed, 15 arc, 723 inc.	.. .. ..	.. .. ..	Tr. 1.4	.. ..	3,461,245 (1905)	Supply to Met. Elec. Trys.; bulk supply to Barnet and Stoke Newington sub-stations	13
.. .. ..	.. .. ..	.. .. ..	.. .. ..	.. ..	Contract on max. dem. & flat rate	1,894,346	Bulk supply to Willesden U.D.C.; supply to Met. Elec. Trys., Middlesex C.C. Lt. Rys., Harrow Road & Paddington Trys.	
.. .. ..	.. .. ..	.. .. ..	8,003	£1 per KW. of max. dem., & 0·9d. to 0·4d. per unit	Max. demand & scale	141,925	Bulk supply to North Metropolitan Elec. Pr. Distribution Co.	
.. .. ..	.. .. ..	.. .. ..	.. .. ..	.. ..	.. ..	.. .. ..	Sec., R. Fleming, 37, Cross Street, Manchester	14
.. .. ..	.. .. ..	.. .. ..	.. .. ..	Pr. 1½ to ½; tr. contract	Max. dem., sl. scale, 2-rate tar. & cont.	.. .. ..	Operations commenced end of 1905; further data not yet available. Sec., Jas. Walker, Scotsman Buildings, 34, North Bridge, Edinburgh	15
.. .. ..	.. .. ..	.. .. ..	.. .. ..	.. ..	.. ..	.. .. ..	Sec., H. Klingner, 26, College Green, Dublin	16
.. .. ..	.. .. ..	.. .. ..	.. .. ..	2½ to ¾	Sliding scale	.. .. ..	Sec., G. P. Tutcher, Royal Chambers, Queen St., Cardiff	17
.. .. ..	.. .. ..	.. .. ..	1,040 KW.	£4 per KW. p.a. & 0·85d. to 0·35d. per unit	Max. demand	.. .. ..	Address: Central Bank Chambers, Leeds. Sec., J. J. H. Stansfield ..	18

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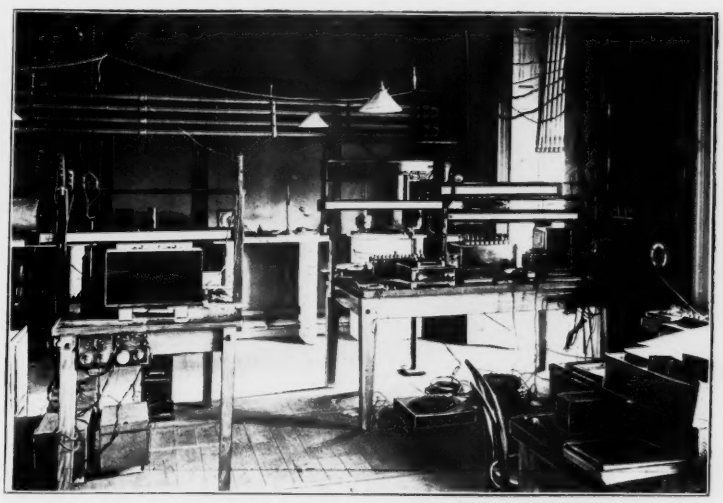
THE NATIONAL PHYSICAL LABORATORY, BUSHEY HOUSE.

(*Concluded from page* 1007.)

One of the bays in the new building is being equipped for the general testing of electrical instruments and apparatus with direct or alternating current—all the machines being arranged on a foundation which is isolated from the walls and floor of the building, and as far away as possible from points where vibration or stray fields would be liable to affect the readings of instruments. Supports on which the more delicate apparatus is to stand, have likewise been isolated from the foundations and walls, by which means it is hoped further to avoid disturbances due to vibration, or the swaying of the walls by wind.

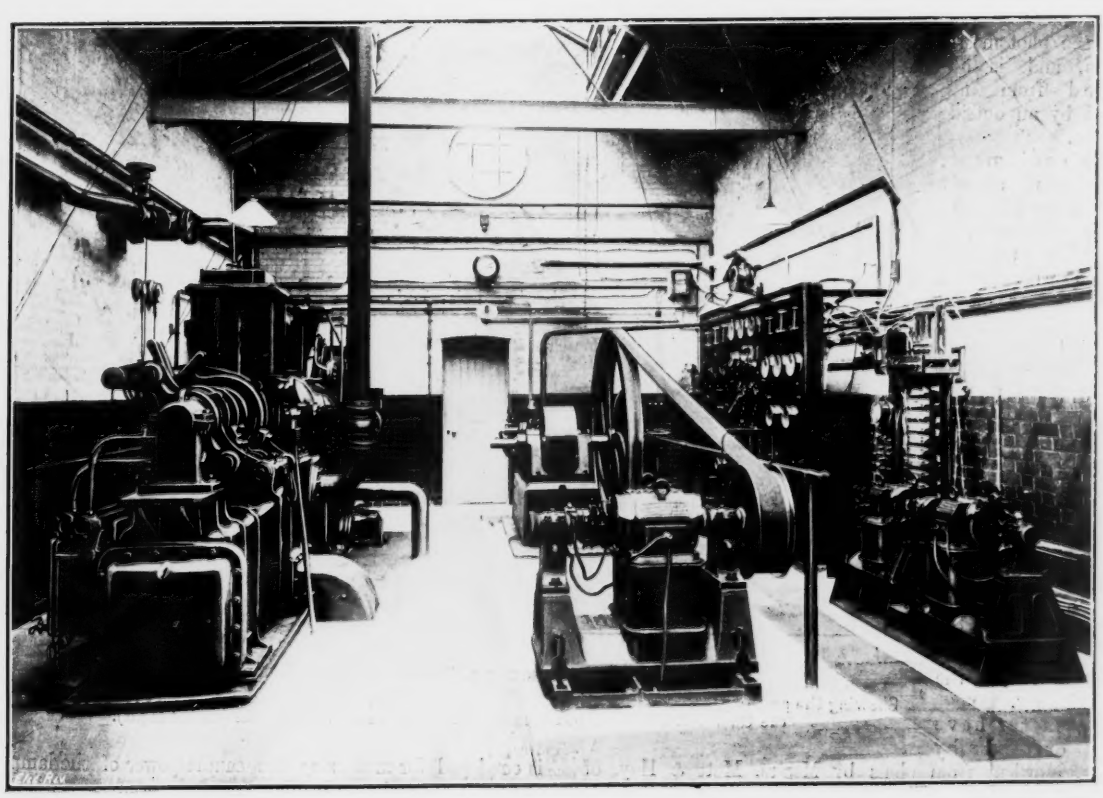


Inductance and Capacity Measurements.
The apparatus on the table, with three galvanometer scales, is for the magnetic study of iron by Searle wattmeter and ballistic galvanometer, &c.

The second large bay has been divided into two, for the purpose of accommodating heavier test work in the one half, and resistance and other direct-current work in the other.

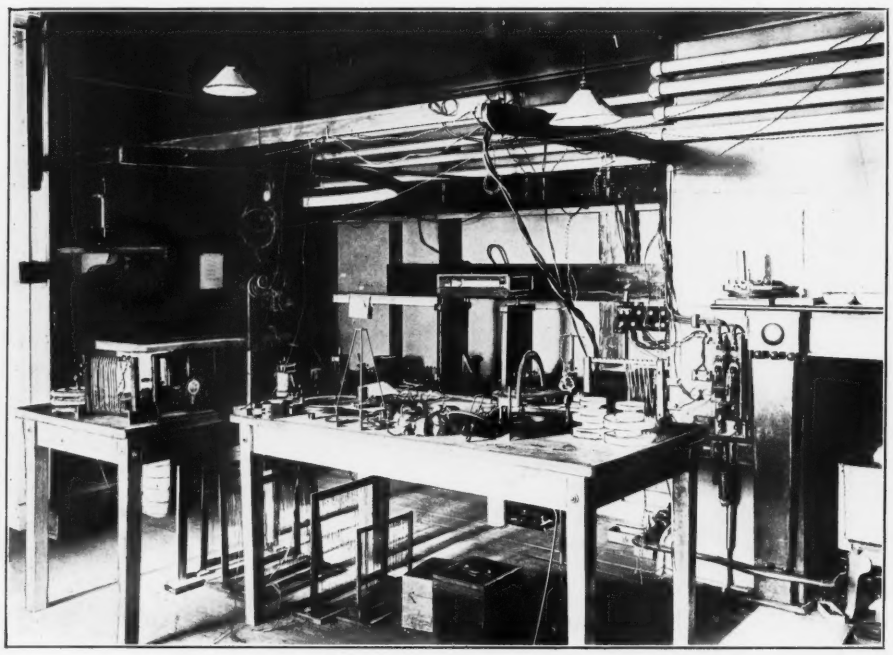
The heavy test room has two machine test-plates, 10 ft. × 5 ft., and provision for a travelling crane. The resistance room is in the centre of the building, well protected on all sides. It measures 60 ft. × 25 ft., and has an extra thick glass roof and a glass ceiling, the space between which will be heated. Special arrangements of inlet and exhaust trunks for regulating the temperature of the air are provided, the entering air being passed over steam pipes.

The photometric section occupies a building running transversely to that just described: an illus-



The Power House in the Engineering Building.
Showing 75-kw. Parsons turbo-generator, 18-h.p. gas engine and dynamo, booster, &c.

tration of it appears in the earlier part of the article. To the south of the resistance room and heavy test room is a second annexe on the ground floor, containing an office, workshop, store room and packing and receiving room.



The Long Scale Kelvin Voltmeter. Scale 2 metres radius. Pressures 40 to 160 volts. By means of a 100,000-ohm resistance, much higher pressures can be used.

The latter building was arranged so as to surround the resistance room entirely and thus assist in maintaining its temperature uniform.

The battery room, which is situated over the photometric section and from which steady currents to the whole building are supplied, has been placed in the roof above the photometric portion, and is approached from the ground by an outside staircase.

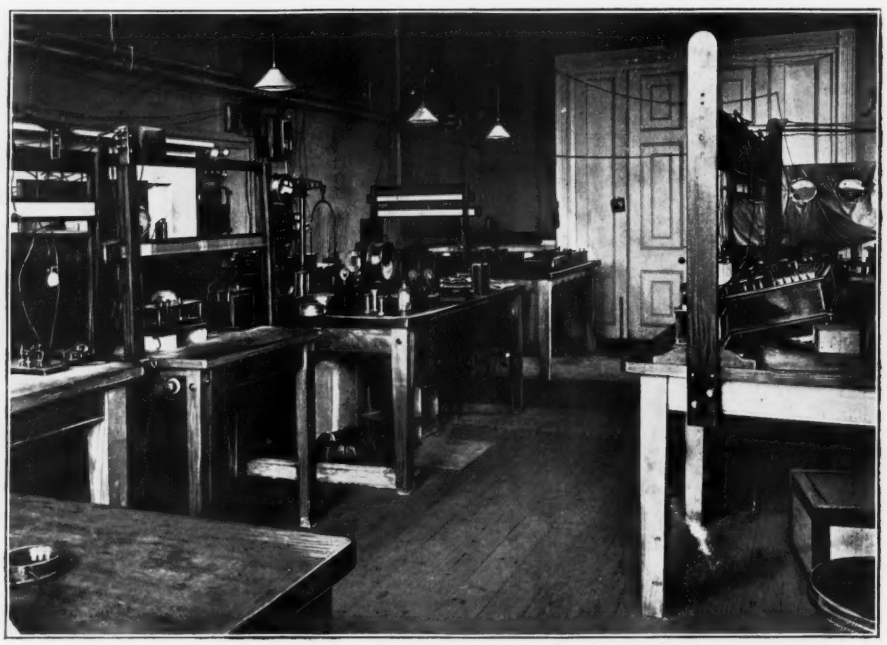
The equipment, which has already been arranged for, includes fixing and connecting up the following apparatus:—One battery of 60 cells, capable of being paralleled for heavy discharges, one battery of 56 cells for machine driving, photometric work and general distribution, paralleling, charging and general switch and distribution boards, a 50-kw. motor-generator and booster with a switchboard for controlling the leads from the engine house to the new buildings.

The latter have been erected by Messrs. Mowlem from plans by Messrs. Mott & Hay, of Queen Anne's Mansions.

One of the departments provided for in the new building, which is deemed most likely to develop quickly, is that of photometry. This department is under the charge of Mr. Paterson and Mr. Rayner. Their work has comprised tests on the most varied types of lamps, from the micro-lamps used in night-sights of guns to powerful arcs, and has included life and efficiency tests on mercury-vapour lamps and tantalum and other metallic-filament lamps. Forty-six standardised electric lamps were issued from the department during the year to serve as standards at various other laboratories.

Comparative tests have been made on arc lamp carbons of five different makes, and the distribution of candle-power from each studied. Complete life and efficiency tests on several new types of metallic-filament lamp have given most interesting and important results.

Tests are also in progress to determine the suitability of various types of glow lamps for signalling purposes, the object being to measure the time taken by the lamps to gain and lose brilliancy after switching on and off respectively. A special apparatus has been constructed for the purpose, by which the lamp, after switching off, is viewed through an aperture in a rotating disk after a given interval, depending on the speed at which the disk is rotated. A similar device is employed for measuring the candle-power of the lamp at the point of maximum brilliancy.



The General Electrical Laboratory (Old Building). Showing the arrangements for insulation testing devised by Mr. Campbell and Mr. Rayner (on the left) and the Gambrell resistance box used in verifying technical resistances (on the right).

The photometric department in the new building covers a ground area of 100 ft. × 25 ft., and consists of two floors,

with the battery room above. The ground floor is divided into two rooms, which will probably be used for life-test work on lamps, and photometry of the more ordinary routine type. Above are a room for accurate standard and experimental work, offices and workshop, and space for arc lamp testing. This latter area measures 52 ft. × 26 ft., and has a well at one end where the full height of the building, viz., 30 ft., can be taken advantage of. It is intended to use this room for the measurement of higher candle-powers, and arrangements have been made whereby a photometer track 90 ft. long can be used along the whole length of the first floor.

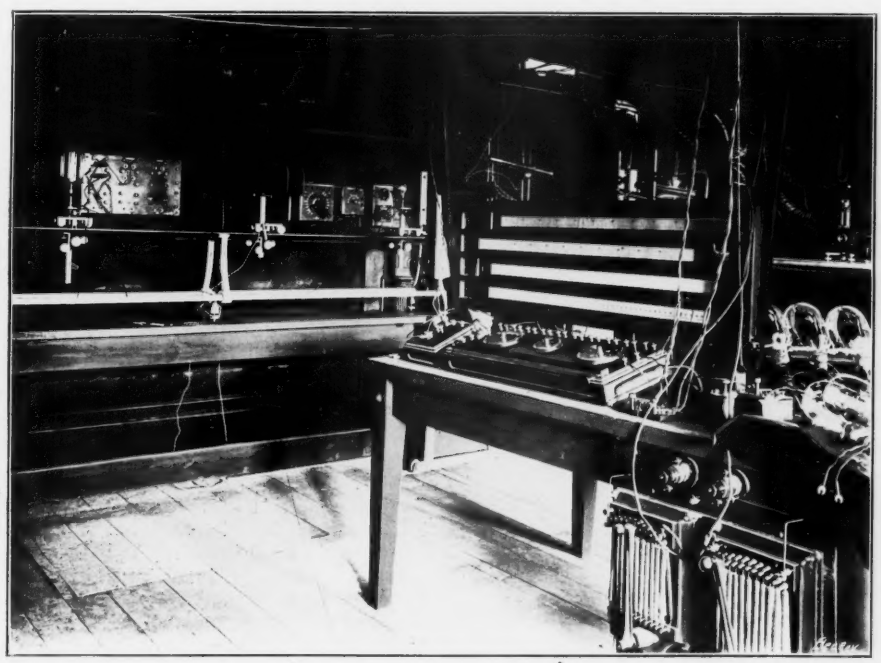
The equipment for the new electrochemical building has yet most of it to be provided. It has been found possible, however, to get the electrostatic voltmeter and wattmeter for use with alternating currents into good working order, and the experience gained in the improvement of the wattmeter will enable a new instrument to be constructed which, it is hoped, will measure alternating power to an accuracy of 0·1 per cent. Experiments have also been made with a low reading electrostatic voltmeter, which can be used as a sensitive alternating current ammeter with 2 volts drop on a series resistance.

The Chemical Laboratory.
Apparatus for steel analysis mounted on the hearth.

Mr. Rayner's researches carried out for the Engineering Standards Committee have been previously described in the electrotechnical Press, as they formed the subject of a paper at the Institution of Electrical Engineers last year. The study of the internal temperatures in the windings of electrical machinery has been extended to transformers, both air and oil cooled, but since the Engineering Standards Committee have not fully considered the matter, the report has not yet been published.

The optical work of the laboratory is, like the themometry, divided between Bushey and Kew. At the observatory many hundreds of telescopes and binoculars with numbers of sextants and other optical instruments are tested annually. The work at Teddington has only just been organised, but Mr. Selby and Mr. Hunter, who divide their time between optical work and the computation of tides, have already carried out numerous measurements of refractive index of absorption with various glasses.

In the department of metrology, or more familiarly weights and measures, Mr. Jeffcott and Mr. Attwell have made thousands of measurements for the Engineering Standards Committee, of gauges and of machine parts. The work of this committee dealing with standard templates for rail and tramways has a special interest at the present time for the electrical engineer.



Photometer Room (Old Building).
This shows the standard photometer for measuring current and pressure in lamps. The lamps mounted on the photometer are an ordinary 16-c.p. incandescent lamp and a Fleming-Ediswan large bulb standard.

The department for metallurgy and metallography under Dr. Carpenter and Mr. Edwards is at present engaged in an elaborate research on the aluminium bronzes. A fine outfit for this kind of work has been provided, which has already been used to great advantage in work published by Dr. Carpenter last year on the high-speed tool steels.

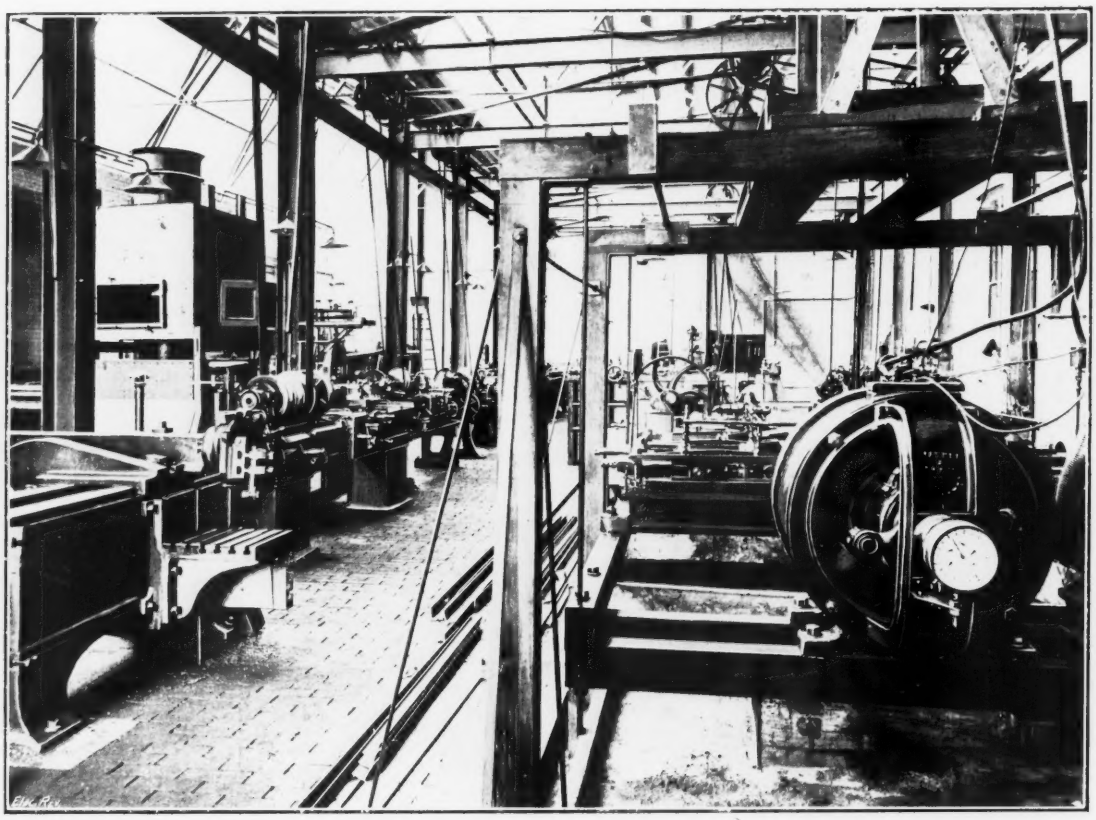
In the chemical laboratory Dr. Caspari has carried out the numerous analyses necessary, and has published some valuable work on the difficult subject of the chemistry of gutta-percha.

The engineering department has been responsible for much constructional work, including the coils for the ampere balance, and the machining of all the specimens used in metallographic research. Dr. Stanton and Mr. Bairstow have continued their work on wind pressure, and the effect on structures has been studied both in natural winds

obtained at the top of a steel tower erected in the grounds and with artificial winds of higher velocities obtained from a large fan. Further interesting work is that of Mr. Jakeman on the physical properties of steam, and the investigations on pressure ganges and on the effects of alternating stresses on metals. The power house in the engineering building has just been enlarged, and a new 50-kw. motor-generator installed, together with several smaller machines. These are in addition to the special machines in the new building, for single, two and multiphase currents of varying frequencies.

Opening of the New Electro-Technical Buildings of the National Physical Laboratory.

On June 25th a numerous and distinguished company visited the National Physical Laboratory at Bushey to be present at the opening of the new Electro-technical Building.



General View of Engineering Building.

To the left is Dr. Stanton and Mr. Bairstow's arrangement for studying wind pressure under artificial draught, and to the right the "repeated loads" machine.

The chair was taken by Lord Rayleigh, President of the Royal Society, and a statement was made by the director, Dr. Glazebrook, giving the history of the movement which has led up to the construction of the present building. The need for extension was brought by the Executive Committee to the notice of the Royal Society in 1904 and received the cordial support of the Council, who laid the matter before the Chancellor of the Exchequer. In this task a prominent place was taken by the ex-President, Sir Wm. Huggins, who, during his term of office, exerted himself at every opportunity on behalf of the extension scheme, and was a member of a deputation to Mr. Balfour, the First Lord of the Treasury, and the Chancellor of the Exchequer, to urge the claims of the Laboratory. As a result Mr. Austen Chamberlain asked Parliament for a grant of £5,000, which was voted last session. This sum, supplemented by an anonymous gift of £2,000, has been used for the erection of the electro-technical building. This was rendered possible by the generosity of Messrs. Mott & Hay, who have given their services as architects, and of Messrs. Mowlem, who, recognising the national character of the work, undertook to erect it at cost price.

For the equipment, the laboratory is indebted to many friends. Messrs. Siemens Bros. led the way with a gift of alternate current outfit. The India-rubber, Gutta-Percha and Telegraph Works Co., Silvertown (Mr. R. K. Gray), and Messrs. Callender have given all the cable needed for power, lighting and experimental work. Messrs. Crompton are supplying the switchboards; Messrs. Mather & Platt some machines: Messrs. Bolton's the copper: and the General Electric Co. (Mr. Hirst) the fittings, on generous terms. The heavy current battery is being obtained from Messrs. Pritchets & Gold, and a switchboard for controlling it from Messrs. Reyrolle, on liberal terms.

About a year ago another grant of £10,000 was obtained from the Chancellor of the Exchequer, chiefly through the exertions of Mr. Haldane, who as president of the British Science Guild, presided at a meeting called in the House of Commons to press the claims of the National Physical Laboratory on the Government. This sum is being expended in the erection of buildings for metrology, metallurgical chemistry and engineering, but it will only cover the cost of the bricks and mortar. For the equipment of the metallurgical laboratory, the Goldsmiths' Co. have made a most welcome grant of £1,000. To complete the three buildings, a sum of at least £5,000 more is needed.

The apparatus which these large and roomy buildings are intended to house is at present stowed away in small rooms and underground cellars in Bushey House. When the electrical, metallurgical, and metrological apparatus is finally transferred to the new buildings already erected, or about to be erected, the staff will work under much more comfortable and favourable conditions than they do at present, and there will be room for large additions to the present equipment. The National Physical Laboratory is already doing excellent work, as may be seen from the report for last year. The investigations carried out appear all to have an important bearing on engineering and industrial problems. The work which was in former days left to the spasmodic efforts of

the private investigator is now carried on by a trained staff with the best apparatus obtainable. The difference in the results obtained will in the course of time be immense.

Mr. Haldane made an excellent opening address. We are fortunate in having one Minister who understands the value of the application of science to industry, and who is thoroughly acquainted with the great progress which the Germans especially have made in this direction. Mr. Haldane pointed out the difference between the Germans and ourselves; in Germany the industries develop out of the laboratories, while here we flounder on without the light of scientific knowledge as long as possible, till we find we can no longer do without it unless we are to fall hopelessly behind in the race for wealth.

LIGHTING and POWER NOTES.

(*Concluded from page* 1042.)

Queenborough.—The T.C. has consented to the Sheerness and District Electric Supply Co. carrying overhead mains in the town, provided the B. of T. does not object.

Stafford.—The T.C. last week decided that £55, representing 6½ per cent. on the wages, be paid to the officials and workmen of the E.L. department, in accordance with an arrangement as to profit-sharing by the employés.

Walthamstow.—We learn from the *Leyton District Times* that Mr. Ross Hooper recently resumed the inquiry into the application of the U.D.C. for sanction to a loan of £8,158 for E.L. works. Since the previous hearing a fresh statement has been prepared showing an excess expenditure to March this year of £1,480. £1,888 is required for services, mains, and meters for the ensuing twelve months. The inspector stated that he intended to go into the question of the excess expenditure very thoroughly. After criticising the Council's method of giving out orders and allocating items of public lighting in the accounts, Mr. Hooper adjourned the inquiry until 29th inst., the engineer in the meantime to prepare a report as to how he finds the machines, Mr. Hooper remarking during the inquiry, "I can't say, from what I have seen of them, that they are satisfactory by any means. There is no doubt, in my mind, that your station has been sadly neglected."

TRAMWAY and RAILWAY NOTES.

Bolton.—The income on the Corporation tramways during the past quarter was £26,241 17s. 6d., an advance of £1,531 8s. 2d. on the corresponding period of last year. The average income per car-mile is 11·57d., against 11·28d. last year. An application on the part of the conductors for an increase of ½d. per hour in wages is being considered by the Tramways Committee.

Burton-on-Trent.—Major Pringle, the B. of T. inspector, has issued his report on the Burton and Ashby Light Railway, which he finds quite satisfactory. The B. of T. has forwarded its certificate, and traffic will commence shortly.

Continental Notes.—ITALY.—It is proposed to convert the horse tramways in the town of Verona to electrical working.

GERMANY.—It is stated that, in order to reduce the danger of collisions on the single-line railway tracks on the Bavarian State Railways, the Bavarian Minister of Public Works has decided to employ wireless telegraphy for sending instructions, warnings, &c., from stations to approaching trains.

Gorton.—The U.D.C. has applied to the B. of T. for a year's extension of time to August, 1908, for carrying out the Tramway Order.

Huddersfield.—A sub-committee has advised that the town clerk shall apply to the B. of T. for a provisional order to be promoted in the next session of Parliament to authorise the extension of the tramways from Crosland Moor to Crosland Hall.

Lancaster.—In order to avoid, if possible, further loss on the Corporation tramways, the Tramway Committee on June 19th decided upon a reconstruction scheme, involving a severance of the existing arrangements of a joint appointment of electrical and tramways engineer and assistant engineer, by which one-half of the salaries of such officials are paid by the Tramways Committee. It was further recommended that a traffic manager should be appointed to undertake the general management of the tramways under the Committee, and that the Electricity Committee should be asked to supply energy at 1½d. per unit, which the Tramways Committee considered to be a reasonable price. A revision of fares was also recommended on the lines of the special report presented by Mr. Clough, of Bury.

Light Railways.—The B. of T. has confirmed the Stretford Light Railways Order, 1906, and the West Manchester Light Railways (New Lines) Order, 1906.

Liverpool.—At a late hour on Sunday night last, a tram-car block occurred on the line of Lime Street and Renshaw Street, Liverpool, through the breaking of an axle on a car proceeding towards the city. Some difficulty was experienced in getting the disabled car out of the way, and a stoppage of the traffic for about 20 minutes was occasioned, an awkward matter, as the main south-end city routes lie along the streets named.

London.—L.C.C.—The Highways Committee on Tuesday reported that the lines in Vauxhall Bridge Road had been converted to the conduit system, and the lines over Vauxhall Bridge were constructed for the same system. As the bridge section could not be worked by electric traction until the powers sought in the Council's Bill had been obtained, the tramways were being worked by horse cars. It was decided to convene a special meeting to consider the question of purchasing the London portion of the Lea Bridge, Leyton and Walthamstow Tramways, and to oppose before the Light Railway Commissioners an application for the construction of light railways specified in the Highgate Hill Light Railways Order.

It was also decided to lodge an appeal to the High Court against a recent decision of the District Commissioners of Inland Revenue with regard to the allowance to be made for depreciation and renewals in arriving at the assessment for income-tax for 1903-4 upon the southern tramways.

ISLINGTON.—On Saturday last a serious accident took place on the electric tramway of the Middlesex County Council leased to the Metropolitan Electric Tramways, Ltd., between Highgate Archway and the Archway Tavern. The driver lost control of the car at the top of the steep gradient, and the car ran away, striking a mourning coach, an empty furniture van, a motor-'bus, and a cab, all of which were wrecked. Finally the car collided with a stationary car at the terminus, and both left the metals, smashing an electric light standard and a motor-car before coming to rest. Three men were killed, and 22 persons injured, four of them seriously.

The B. of T. has appointed Lieut.-Col. H. A. Yorke, C.B., to inquire into the circumstances of the accident, and an inquest on the three victims was opened on Tuesday at Islington. Mr. Horace Avory, K.C., appeared for the company, and other interests were also represented by counsel.

The driver, E. H. Cone, stated that he had been driving on the Highgate route 22 days, and had previously spent a month in the school at Hendon, but had had no previous experience. His evidence showed that he had had trouble with the brakes on the car twice on the same afternoon, immediately prior to the accident, owing to the wheels skidding. When the car refused to stop at the Archway, he released the hand-brakes, but the wheels still skidded; the magnetic brakes also would not act. He reversed the controller without effect, and eventually, after smashing the hearse, seeing a furniture van on the track, he jumped off. The road was very greasy. The brakes on the car were a hand brake and a magnetic brake; the latter was used on an emergency, and if the wheels were not revolving, it was useless. Skidding was of daily occurrence. Mr. A. H. Pott, chief engineer of the Metropolitan Electric Tramways, Ltd., said that skidding was a sign of bad driving, and was reported to the traffic manager, who dispensed with the services of the driver responsible. There were flats on the wheels of the car in question. He thought the accident was due to an error of judgment on the part of the driver.

The witness thought the present brakes the best possible. The car had just been renovated and inspected, and Saturday was the first day on which it was being used again.

Other evidence was given, and the inquests were adjourned till July 10th.

BERLIN TRAFFIC COMMISSION.—The Commission sent from Berlin to report on the methods of dealing with traffic in London and Paris has presented its preliminary report. According to the *Tribune*, the Commission was very favourably impressed with the speed and efficiency of the London railways under modern conditions, but commented on the bad atmosphere prevailing in the London "Tubes," and one of these in particular. The method of collection of tickets employed on the Central London Railway is praised as a pleasant contrast to the troublesome supervision on the Berlin electric line. The carriages and the lighting arrangements were found to be better in London than in Paris or Berlin. On the whole, however, both London and Paris were found to be in advance of Berlin in the matter of electric railways.

Travellers on the "Bakerloo" Railway this week were requested not to drop their tickets into the chopping-box at the entrances to the stations as usual, but to deliver them to the lift-man at the station at which they alighted. The object is to dispense, if possible, with the attendants at the boxes. It is rumoured that the change may be followed by the introduction of fares varying with the distance.

Manchester.—The annual report of the working of the tramways, prepared by the general manager, Mr. J. M. McElroy, was approved by the Corporation Tramways Committee at its meeting on Tuesday, and will be submitted to the City Council at its next meeting. At the date of his last report, the manager says the total length of single track open for traffic was 146 miles 342 yards; this has been increased to 157 miles 647 yards. The total

traffic revenue for the year amounted to £661,806, as compared with £628,529 in the preceding year. This sum was increased by other sources of income to £663,706. The working expenses amounted to £433,560, against £411,597 last year, leaving a balance, with the addition of bank interest, of £232,097, against £222,227 in 1905. Out of this sum the following charges have to be met:—Interest on mortgage debt, &c., £48,731; redemption of debt, £38,594; rent of tramways, £17,250; leaseholds (proportion of outlay), £930; and income-tax, £6,418. The available balance was appropriated as follows:—Renewals for depreciation account, £70,082; street improvements, £4,090; contribution in aid of rates, £46,000; total, £120,172. The number of passengers carried during the year was 133,923,932, as compared with 126,900,875 in the previous year. The following facts are brought out by a table showing the percentage of passengers carried at different fares:—70·76 per cent. paid 1d. fares; 11·57, 1½d. fares; 6·25, ½d.; and only ·32, 4d. fares. The average traffic revenue per car-mile was 10·84d., against 10·68d. in the preceding year, and the average working expenses per car-mile, excluding power, cost 5d., as in the preceding year. Including power cost, the working expenses amounted to 7·10d. per car-mile, against 6·99d. in 1905. This difference is due to the increased number of covered cars. The renewals and depreciation fund now stands at £249,211, against £185,085 at the end of the last financial year.

Middlesex.—According to the *Daily Express*, the Metropolitan Electric Tramways, Ltd., has made an application to the B. of T. for the approval of a by-law permitting any number of passengers not exceeding one-third of the number for which the vehicle is licensed, to stand inside during inclement weather, provided each person first obtains the consent of the conductor. The same privilege is also asked for Sundays and Bank Holidays or other public holidays, and for Saturday afternoons, with the consent of the Commissioner of Police.

Newcastle.—The Mayor proposed to hold a joint meeting of the sub-committee appointed to deal with the matters in dispute and the men's representatives, and to submit points upon which agreement could not be reached to arbitration; but the union rejected this on the ground that an impartial judge was unobtainable. The men had resolved to come out on strike during race week, but agreed to remain at work during the holidays, to secure the support of the ratepayers.

Paisley.—The extension of the Paisley tramways from Potterhill to Barrhead was opened this week.

Rawtenstall.—Mr. Lacey, of Messrs. Lacey, Sillar and Leigh, has advised the T.C. that the time has arrived when the Council should proceed with the purchase of the local tramways. The question of obtaining energy in bulk, or the establishment of electricity works, has been left for a committee to consider.

South Lancashire.—The Lancashire United Tramways Co. ran a trial trip on their new line from Brookhouse, Farnworth, to the Ellesmere Monument, Walkden, on Friday last, with satisfactory results. Excellent progress is being made with the construction of their other lines from Walkden to Swinton, Worsley, Winton and Bootbstown.

South Shields.—On the 23rd inst., Col. von Donop, on behalf of the B. of T., made an official inspection of the Frederick Street to Slake Terrace section of the Corporation tramways. Cars were taken over the route, and particular attention was given to that part of the way where the road has been lowered at St. Mary's Terrace. The inspection seemed quite satisfactory, for immediately afterwards the service was inaugurated. This is the second route finished.

Weymouth.—A poll of ratepayers on the question of permitting a company to construct electric tramways between Upwey and Portland last week resulted in a large majority against the project.

United States.—According to a New York correspondent of the *Standard*, the death-roll in connection with the tunnel borings under the East River in connection with the underground railway project is mounting with alarming rapidity, being increased on the 20th inst. by two drowning accidents. A foreman and his gang were working at a tunnel heading about 300 ft. from the shore, and in a rock stratum about 110 ft. below the surface of the river. The men had plugged a crevice made by a small "blow-out," but the new air-blast had evidently enlarged the fissure through the rock to the quicksand. Two men were drowned outside the shield by the inrush of water, and the rest barely managed to escape through the second small emergency door. The foreman crawled through as the water rose a foot per second.

The engineers confess themselves nonplussed by the repeated "blow-outs" and "bends" owing to the high air-pressure, these latter alone causing numerous accidents amongst the workers. The actual number of deaths since the commencement of the four tunnels has not yet been stated. The chief doctor to the contractors, Messrs. Pearson & Co., told the coroner that some men, when placed in the medical air-lock in the works, failed to come round, while recovery was practically hopeless at the hospitals unprovided with a special air chamber.

TELEGRAPH and TELEPHONE NOTES.

American Pacific Cable.—The daily Press announces the opening of the Tokio-Guam section of the American Pacific cable.

Austria.—The Austrian system of telegraphs in 1904, including 186·99 kilometres of underground cables, and 418·33 kilometres of submarine cable, amounted to 41,683 kilometres of line, and 188,157 kilometres of wire, the increase on the previous year being 1,744 kilometres of line, and 10,158 kilometres of wire.

The systems of railway and private telegraph lines were reduced during the year by 647·95 and 184·85 kilometres respectively. 89·94 per cent. of the conductors of the State lines is of iron-wire; 6·04 per cent. of bronze; 0·23 per cent. of compound; and 0·13 per cent. of steel wire. At the end of the year there were 6,269 telegraph offices open to the public—namely, 3,834 Government, 2,417 railway and 18 private offices.

Traffic.—1,849,050 Government and service telegrams were dealt with during the year, while paid telegrams numbered 17,220,837, an increase over the previous year of 757,183. Of the former number 1,485,447 were telegrams in transit, while the balance was exchanged with Hungary, Bosnia and foreign countries. The following figures show the movement of telegrams:—Germany sent and received 2,331,115 telegrams; Hungary, 1,798,608; Italy, 288,480; Great Britain, 255,484; France, 238,762; Russia in Europe, 199,436; Switzerland, 136,051; Roumania, 107,332; Bosnia, 132,747; and Turkey in Asia and Europe, 66,706. The international traffic totalled 7,345,736 telegrams. Among the telegrams handled there were 119,975 urgent telegrams, 100,187 telegrams paid for in cash, and 188,408 in stamps; and altogether 420 telegrams per 1,000 inhabitants were sent.

Vienna and Prague were the busiest centres, claiming each 5,036,923 and 1,063,232 telegrams sent and received. Then follow Trieste with 952,075; Lemberg, with 490,798; Graz with 370,985; Cracovie with 272,422; Brünn with 268,967; and Carlsbad with 218,972. The Pneumatic service handled 3,793,611 telegrams.

The receipts for 1904 were 12,419,928 fr. They have steadily risen from 10,546,862 fr., the revenue for 1900.

Telephones.—There were 208,217·88 kilometres of underground wire and 53,165·19 kilometres of aerial wire. Telephonic conversations amounted to 157,508,263, of which 1,590,942 were telegrams forwarded by telephone. The telephonic receipts amounted to 8,239,316 fr.—*Journal Télégraphique.*

Belgium.—On the Belgian telegraph system in 1904 there were transmitted 6,722,254 telegrams, being an increase of 2·40 per cent. over 1903, in which year 6,564,335 telegrams were dealt with. The receipts amounted to 4,502,901 fr., as against 4,418,063 fr. in 1903, or an increase of 1·92 per cent. The above figures include internal, international and transit telegrams. There was an increase in the number of inland and foreign telegrams due, it is said, to greater business activity.

The Anglo-German transit traffic increased by 6·89 per cent. during the year.

Government and service telegrams numbered 8,744,340, of which 221,580 were on account of the service. 2,198 offices were open to the public in 1904, as against 2,162 in 1903. The *personnel* numbered 11,673, being an increase of 402 over 1903.

The receipts on account of the telegraph service amounted to 5,008,893 fr., while the telephonic service yielded 6,194,112 fr., together 11,203,005 fr. The expenses of the joint services were 7,618,063 fr., leaving a surplus of 3,584,942 fr. The capital account is represented by 49,522,409 fr.

A large extension of the telephonic service was necessary during the year, owing to the large increase in the number of subscribers, who numbered 20,875, or an increase of 1,986 over 1903.

Local conversations paid for numbered 62,514, an increase of 6,016 over 1903, while telegrams telephoned increased by 99,197 to 1,691,623. The receipts on this account totalled 4,956,011 fr., an increase of 554,589 fr.

International conversations increased by 22,319 to 221,299, the receipts on this account also increasing by 67,750 fr. to 435,041 fr. —*Journal Télégraphique.*

India.—It is proposed to provide and fix telephone instruments along the E.I.R. line at a cost of about Rs. 27,000, in addition to the existing stock.—*Indian Engineering.*

National Telephone Co.—The company has agreed to increase the wages of telephone operators for Sunday work, and to limit the latter to one half-day in four weeks. The hours of the night operators have not been reduced.

The New Pacific Cable.—A complimentary dinner was given at Shanghai in April by the American Association of China to the general manager of the Commercial Pacific Cable Co., Mr. George Gray Ward, of New York. There were 46 who sat down to table, half being guests. The president of the Association, Dr. Gilbert Reid, presided at one end, and the Consul-General for the United States, Mr. James L. Rodgers, presided at the other. The object of the event was to celebrate the completion of the new Pacific cable.

Paris-Rome.—The telephone service between Paris, Lyons and Rome is to be opened on July 1st. The price will be 4 fr. between Paris and Rome by day, and 2 fr. by night, per call of three minutes.

Telegraphic Interruptions and Repairs :—

CABLES.	INTERRUPTED.	REPAIRED.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Beissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Port Arthur-Chifu (Closed)	Mar. 7, 1904	
Tarifa-Tangier	Jan. 18, 1904	
LANDLINES.		
Puerto-Barrios	Aug. 28, 1902	
Bachkale-Deliman	Feb. 12, 1906	
Trebizonde-Batoum	June 25, 1906	

Wireless Telegraphy.—From a letter which was published in the *Standard* on the 19th inst., signed by the secretary of the Lodge-Muirhead Wireless and General Telegraph Syndicate, Ltd., in reply to one emanating from the managing director of the Marconi Wireless Telegraph Co., Ltd., it appears that the former has commenced legal proceedings against the Marconi Co., in which the latter will have an opportunity of establishing the validity of Mr. Marconi's patents.

CONTRACTS OPEN and CLOSED.

OPEN.

Belgium.—July 6th. The municipal authorities of Brussels are inviting tenders for the supply and erection of 108 arc lamps and for 18,000 pairs of arc lamp carbons.

Bolton.—July 12th. Condensing apparatus for the electricity department. See "Official Notices" to-day.

Dublin.—July 9th. Sub-station switchboards and accessories; transformer pillars for the Corporation. See "Official Notices" to-day.

Dublin.—July 9th. Certain electric works for the Board of Public Works. See "Official Notices" to-day.

Glasgow.—July 2nd. The Corporation invites tenders for the electric light installation, &c., for Townhead District Library. Specifications on application to Mr. John Fairweather, Architect, 136, Wellington Street, Glasgow.

Hackney.—July 26th. Arc lamps and arc lamp pillars, switch pillars, &c., for the Council. See "Official Notices" to-day.

Leeds.—July 16th. The Electricity Committee invites tenders for 150 tons of coal tar pitch.

L.C.C.—July 10th. High and low tension cables for the tramways. See "Official Notices" June 22nd.

London.—July 3rd. Tramway car fittings, motors, insulating material, &c., for the L.C.C. See "Official Notices" June 22nd.

Melbourne.—August 7th. Tenders are invited for the supply of 20,000 Western Union pattern double shed single groove glass insulators (5,000 to be delivered at Sydney, Melbourne, Adelaide and Brisbane, respectively); and 5,000 double groove glass insulators (1,250 to be delivered at Sydney, Melbourne, Adelaide and Brisbane, respectively). Specifications, &c., at the General Post Offices at Sydney, Melbourne, Brisbane and Adelaide. —*Board of Trade Journal.*

Middlesex.—The Middlesex County Council invites tenders for work and materials required in the construction of the permanent way (for electric traction), bridge work, road widenings, for three miles of line.

Oldham.—July 4th. Tenders for the ventilating and electric lighting of the new Council school at Clarksfield. J. Rennie, Secretary, Education Offices, Oldham.

Rotherham.—June 30th. Cables and meters for one year for the Corporation. See "Official Notices" June 15th.

Roumania.—July 10th. The municipal authorities of Focshani are inviting tenders for the concession for the electric lighting of the town.

Spain.—The municipal authorities of San Felio de Torello (Barcelona province) have just invited tenders for the concession for the electric lighting of the town during a period of 9½ years.

Twickenham.—July 11th. Electric lighting installation for the U.D.C. sewage disposal and destructor works. See "Official Notices" June 22nd.

Wallasey.—July 16th. A.C. transformers for the U.D.C. See "Official Notices" June 15th.

West Ham.—July 13th. Cable and transformers for the electricity department. See "Official Notices" to-day.

CLOSED.

Bexhill.—The B.C. has ordered one condensation water purifier and grease eliminator, with quartz sand filter, for its electricity works from the Paterson Engineering Co., Ltd.

Bury (Lancs.).—The T.C. has accepted the tender of Messrs. Mountain & Gibson, of Eltonfold, Bury, for one tramway track watering and cleaning car.

Cardiff.—The Corporation Asylum Committee received two tenders for the electric light wiring of the cottages for attendants at the institution, viz., Messrs. Arnold & Son, for £158, and Messrs. J. B. Saunders & Co., for £243. The lowest tender was accepted subject to the approval of the electrical engineer.

Croydon.—The T.C. received the following tenders for the overhead equipment of the Whitehorse Road tramways:—

R. W. Blackwell & Co.	(accepted)	£601
British Electric Equipment Co.		547
Brush Electrical Engineering Co.		560
Johnson & Phillips		1,157

The T.C. has accepted the tender of the British Thomson-Houston Co. for the supply of a watering car, at £619 10s.; and that of the British Westinghouse Electric & Manufacturing Co. for 10 tramcars, at £521 10s. each.

Darlington.—The Corporation has accepted the tender of the Haste Pump Co., Ltd., for condensing plant, including counter-current jet condenser with steam driven air and water pumps, for its lighting station.

Gravesend.—The Corporation has placed an order for a cold process water softener, with quartz sand filter of 1,500 gallons hourly capacity, for its electricity works, with the Paterson Engineering Co., Ltd.

India.—It is stated that Messrs. Dorman, Long & Co. have received a large order for telegraph and cable wire for the Indian Government.

London.—We have received the following list of tenders submitted for the installations at the new Lambeth municipal buildings now erecting at Brixton. The consulting engineer is Mr. H. G. Bentley Taylor.

Charles Hacking	£691	Wright Bros.	£478
Sheldrick & Co.	636	Strode & Co. (accepted)	477
S. Burnby & Son	560		

BATTERSEA.—The B.C. has accepted the tender of Messrs. Evered and Co., Ltd., for electrical fittings for the museum, recreation room and gymnasium, Plough Road.

HAMMERSMITH.—The B.C. has placed an order with Messrs. Arthur Ross, Hotchkiss & Co. to fix Hotchkiss circulators to the seven boilers not already fitted with same. The price is £42, less 10 per cent. The tender of Messrs. A. B Bosher & Co. (at £77) has been accepted for the annual supply of files to the electricity works.

SOUTHWARK.—The B.C. has received the following tenders for the supply of two 40-H.P. electric motors, &c., for the Manor Place depôt:—

Cutting Bros.	£250
Chain Belt Engineering Co.	269
Bruce Peebles & Co.	315
Mather & Platt	264
General Electric Co.	280
Westinghouse Electric Co.	376
Lancashire Dynamo Co.	278
Siemens Bros.	363
Electrical Construction Co. (accepted)	235

POPLAR.—The B.C. some time ago received the following tenders for coal conveying plant at the electricity works:—

Babcock & Wilcox	£2,107	New Conveyor Co.	£1,872
Ed. Allen & Co.	1,475	Gibbons Bros.	1,636
Ed. Bennis & Co.	1,410		

In order that the firms might be brought into line with each other, the borough electrical engineer asked them to send in amended prices including all foundations and certain details which would be of advantage. The Electricity Committee reported on Wednesday having received the following amended tenders:—

Babcock & Wilcox (recommended for acceptance)	£2,158
Ed. Allen & Co.	1,655
Ed. Bennis & Co.	1,520
New Conveyor Co.	2,150
Gibbons Bros.	1,875

The New Conveyor Co. wrote that they did not care to give a fixed price for the foundation work, but preferred to have the same carried out by day work. Therefore, there had been added on to their tender the figure given by the borough surveyor for foundations, viz., £235.

West Ham.—The Corporation, having considered a report of the electrical engineer on the tests made of the incandescent electric lamps of English manufacture, submitted by the six lowest firms tendering, have accepted the tender of Mackeys' Electric Lamp Co., Ltd. An order has been given to Messrs. Cory and Co. for a further supply of 5,000 tons of coal, at 9s. 5d. per ton.

FORTHCOMING EVENTS.

Monday, July 2nd.—At 8 p.m. Faraday Society. Special meeting at Society of Arts. Prof. Kr. Birkeland, of Christiania, on "The Oxidation of Atmospheric Nitrogen in Electric Arcs"; and Mr. F. W. Harbord will read a paper by Dr. Eugen Haanel, of Ottawa, on "Experiments on Electric Iron and Steel Smelting at Sault Ste. Marie on Behalf of the Canadian Government."

Thursday, July 5th.—At 8.30 p.m. Chemical Society. Mr. H. D. Law on "Electrolytic Oxidation."

NOTES.

The L.C.C. Power Bill Thrown Out.—Yesterday the Select Committee threw out the L.C.C. Power Bill.

The Marylebone Electricity Department's Annual Dinner.—A befitting celebration of the first year of working of the largest municipal undertaking in London, took place on Saturday last, when some hundred members of the staff of the St. Marylebone Electricity Department sat down to a "first annual dinner" at the Restaurant Frascati. Despite the excitements and fatigues of a cricket match between the North Street and York Place staffs, which took place earlier in the day, and in which York Place were the victors, the members fell to with renewed vigour and discussed a substantial dinner menu, which was followed by an equally substantial programme of music, both instrumental and vocal, during the remainder of the evening. Mr. F. A. Wilkinson, the resident electrical engineer and manager of the Marylebone Electricity Department, occupied the chair, and was supported by prominent members of his staff; Mr. C. H. Smyth, his able superintendent of mains, acted as vice-chairman. The toast list was a commendably brief one, and the menu undisfigured by electro-dinner'mical equivalents, while through the energetic photography of Messrs. Fradelle and Young, those present were enabled to view a record of the event during the course of the evening.

Of the concert, with its many able participants, one can only say that it was a most successful example of its kind. An embarassing lady impersonator, similarly embarassing though excellently rendered Welsh and Scotch songs, pianoforte duets, flute solos, and other turns too numerous to mention, helped to pass a very enjoyable evening.

Before dispersing, the good offices of the chairman received suitable acknowledgment, and Mr. Wilkinson, in responding, referred to the very successful development of the electricity department, which had now 6,500 consumers connected. Mr. J. Fuller, the hon. secretary, on whom devolved the task of organisation, is to be congratulated on the very happy result of his labours.

Much Ado About Little.—In order that he might go through the gate and put a woman relative on a train, Paul Etheridge, of Atlanta, bought a Central of Georgia ticket, good to the first station beyond. It cost him 18 cents, and not being used he sought its redemption. This was refused, although the ticket was stamped "redeemable if not used." Etheridge sued the railroad in a Justice's Court, and was awarded 18 cents with costs. The railroad company, on a writ of *certiorari*, carried the case to the Superior Court, alleging that the plaintiff pretended to enter into a contract with intent to deceive and defraud the company, and had carried out such deception; that the contract had been fully carried out by the defendant company. The Court, however, has sustained the original verdict. The railroad company will carry the case to the highest tribunal!

Canadian Hydro-Electric Power Commission.—The Provincial Cabinet of Ontario have appointed the Hydro-Electric Power Commission of Ontario, the members consisting of the Hon. Adam Beck, M.P.P., of London; Hon. J. S. Hendrie, M.P.P., for West Hamilton; Cecil R. Smith, C.E., of Toronto. The two former members of the Government are debarred from receiving salaries, but it is thought a new minister will be appointed to be known as the Minister of Power, with a salary equal to that of other ministers with portfolio. The new Commission is empowered to carry out the Government's policy of supplying municipalities with cheap electric power.

Arc Works Annual Sports.—Crompton's Annual Sports, or, to be more accurate, "the Athletic and Bicycle Race Meeting," took place at the Club Grounds last Saturday, 23rd inst., and was quite an unqualified success in every way. The weather was delightful, and in marked contrast to the experience of last year. As usual, the visitors were taken down by special carriages from Liverpool Street, and were first conducted over the works being afterwards entertained to luncheon before the sports took place. The chairman of the company presided over the luncheon, and in welcoming the guests, said he hoped that they had been interested in what they had seen of the works, and emphasised the fact that Crompton's had always maintained the very highest standard of excellence in manufacture, notwithstanding the extra stress of competition both from without and within. Mr. J. P. Mulholland, in replying to the chairman's welcome, said that we had not much to learn from America as regards manufacture, but that America had learned a great deal from us, particularly in the suggestions and hints scattered by British engineers during their too infrequent visits to the States. These ideas were seized upon and elaborated and re-exported to England in such a form that we could scarcely distinguish them as our own. Col. Crompton also spoke, and expressed his opinion that England was still in the front rank of manufacturing nations notwithstanding the wails of certain sections of the daily Press. He pointed out that England had taken the lead in proposing a permanent international commission for the standardisation of engineering terms, &c., and that England would be the country in which the first meeting would be held, English would be the official language of the commission, and an Englishman would be the first chairman. The name of the latter did not transpire, but, unless we are misinformed, the Englishman referred to is a Scotchman, and that Scotchman again an Irishman. The sports passed off most successfully and a most pleasant afternoon was spent.

Greenwich Observatory.—We do not mind fair criticism, but when words are put in our mouths in order to represent us as saying something that we never said, and thus to afford our critics an opportunity of pointing at us the finger of scorn, we feel that it is necessary to utter a strong protest. In a recent issue the *Electrical Times* credits us with saying that "observations of this character—*i.e.*, transit observations—are not of frequent occurrence, or of fundamental importance," and proceeds to ridicule our assumption of knowledge of the working of an Observatory.

As a matter of fact, the words "transit observations" did not occur anywhere in our article; they have been deliberately interpolated by our contemporary, whose action constitutes a—perversion of fact. We said, as our readers are aware, that telescopic observations of stars in the vicinity of the northern horizon were affected, but "probably observations of this character,"—that is, observations near the northern horizon—"are not of frequent occurrence, or of fundamental importance." Our statement was correct; we know, and our critic knows that we know, that transit observations form a very large part of the routine work of an observatory such as the one in question, and the false impression conveyed by his mis-quotation savours of malicious intent.

Electric Shock Fatalities.—On Friday morning last a rivet heater, named Henry McMahon, 18 years of age, was found lying in contact with the N.E. Railway live rail on the Riverside branch, between Percy Main and Willington Quay. There was no right of way or public crossing at or near the place. The jury found that deceased was "electrocuted" whilst trespassing, and that there was no evidence to show how he got on to the line. Artificial respiration was tried for over half-an-hour, but without success.

In our last issue we mentioned a fatality which occurred at the Pyle and Blaina Works, causing the death of a man named Rees. At the inquest the jury returned a verdict "That deceased was killed directly or indirectly by receiving an electric shock from naked terminals or wires, improperly left bare." The voltage was 440.

A Scottish correspondent writes:—"Great interest has been taken by Scottish colliery managers in the fatal accident which took place in one of the Arniston pits. A man had been working an electric coal-cutting machine, and had taken hold of a wire haulage rope for the purpose of adjusting it. He at once collapsed and never recovered. It was stated at the subsequent official inquiry by an electrical expert, that when the electricity was suddenly taken off there was a certain recoil which might get into the iron-work of the machine. It would be very light, and might get into the cable. He, however, did not see that the current would be strong enough to kill a man. Medical evidence was to the effect that death was due to severe shock."

Conversazione of the Institution of Electrical Engineers.—On Tuesday last the annual conversazione of the I.E.E. was held, as usual, at the Natural History Museum, South Kensington. The President and Mrs. Gavey, with the President-Elect and Mrs. Glazebrook, and the Council, received the guests, who numbered about 1,700, and included many well-known scientists, engineers, &c., among them being most of the foreign visitors. The Central Hall was tastefully decorated and lighted with arc lamps; the String Band of the Royal Engineers, conducted by Mr. N. Flux, A.R.A.M. R.E., performed an excellent programme of music there, and the Leoni Ladies' Quintette, performed a like service in the Reptilia Gallery. The function was as enjoyable and harmonious as it always is, and that is synonymous with declaring it to be a success in every way.

Institution Notes.—ROYAL SOCIETY.—The following papers were down for reading at yesterday's reading:—

Mr. O. W. Richardson, on "The Ionisation Produced by Hot Platinum in Different Gases." Communicated by Prof. J. J. Thomson.

Sir William Crookes, "On the Ultra-Violet Spectrum of Ytterbium."

Dr. J. A. Harker, "On the 'Kew' Scale of Temperature and its Relation to the International Hydrogen Scale." Communicated by Dr. R. T. Glazebrook.

Mr. W. H. Logeman, on "Note on the Production of Secondary Rays by 'a' Rays from Polonium." Communicated by Prof. J. J. Thomson.

Annual Outing.—On Saturday last the annual outing of the staff of the Stepney Borough Council electricity department took place to Clacton-on-Sea. Travelling by special train, the party reached their destination at 9 a.m. Dinner was served at the Brunswick Hotel at noon. Mr. W. Young was elected chairman, with Mr. A. J. Somerville in the vice-chair. After the toast of "The King and Queen and Royal Family," and "The Electrical Committee and the Electrical Engineers," had been proposed and drunk, the chairman expressed his pleasure at once again meeting the staff under such happy circumstances, and regretted that the exigencies of business prevented all the staff from attending. He then proposed a vote of thanks to the hon. treasurer and secretary, Mr. E. E. Dorking, and the Outing Committee, to whose efforts the success of the outing was largely due. The afternoon was spent in drives and walks in the vicinity.

Engineering Trade Troubles.—The *Morning Post* states:—"The Amalgamated Society of Engineers, in conjunction with the Steam Engine Makers' Society and the United Machine Workers' Association, have asked the Engineering Employers' Federation to convene a central conference for the purpose of reconsidering the terms of settlement which were jointly adopted after the disastrous strike in 1897. Three of the amendments to be submitted by the employés sufficiently indicate the drastic nature of the proposed changes. One is that the Federation shall recommend the preferential employment of society men instead of leaving firms to employ whom they choose, another seeks to set up a limitation of apprentices, and the third asks that the maximum overtime shall be 20 hours per man per month instead of 40 hours as at present. The terms of settlement have been in operation since January, 1898, and since then there has been industrial peace, while the operatives have prospered individually and collectively, the Amalgamated Society now having a membership of 100,000 with funds amounting to over £700,000. It is not expected that the employers, who have already sacrificed much for freedom of management, will make the concessions asked, and if the men remain firm a serious situation is sure to develop."

Steam Turbines and Gust Regulation.—Visitors to the London Road station on Wednesday, June 20th, had the opportunity of observing the effect of gust regulation, even on a turbine heavily loaded. The pressure gauge finger indicated a variation of pressure from 120 lb. to 180 lb., *i.e.*, a range of 60 lb. pressure, and about 3° F. of temperature, thus showing that as loads drop below maximum, there is a decided range of temperature over an enormous surface, and without superheated steam there must be much cylinder condensation.

Appointments Vacant.—Three shift engineers for a large central station in the South of England; draughtsman for Brighton Corporation Electricity Works; commercial assistant for the Woolwich B.C. electricity department (£200).

Hammersmith, City and North-East Railway Bill.—The Chairman of Ways and Means has given notice of his intention to move in the House that the promoters of the above Bill, which has been introduced into this present session, shall have leave to suspend any further proceedings thereon, in order to proceed with the same Bill if they think fit in the next session of Parliament, provided that notice of their intention to do so be lodged in the Private Bill Office not later than six o'clock on the day prior to the close of the present session, and that all fees due thereon up to that period be paid.

The "Daily Mail" again.—In a leader published on the 25th inst. the *D.M.*, referring to the Highgate disaster, with novel phrases such as "dashed down the hill," "its mad career," and so on, took objection to power brakes on the score that too many of them "depend on the electric current for their source of energy, and the moment the trolley leaves the wire or the current fails on the wire, the brake becomes useless." We suppose it is useless to inform our contemporary that no electric brake in use in any way depends upon the continuity of the tramway power supply.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Engineers.—The following changes have taken place in the staff of the West Ham Electricity Department: Mr. Perry, boiler house superintendent, has resigned. The vacancy is not to be filled, but Mr. S. M. HOPEWELL, late in charge of the Manchester Corporation Motor Department, has been appointed at the same salary as Mr. Perry was receiving, to take charge of the Motor Hiring and Power Supply Development Department. Mr. Kemble, shift engineer, has resigned, and has been succeeded by Mr. MIDWINTER, late shift engineer in the employ of the County of London Supply Co., at a salary of 50s. per week. Mr. Forster, draughtsman and spare charge engineer, has resigned. The vacancy is not to be filled, as the amount of drawing work in the office has decreased. The salary of Mr. MASTERS, assistant station superintendent, is to be increased from £150 to £175 a year, and he is to be given the title of resident engineer. Mr. Masters is to undertake to remain for two years in the Council's service, and to take up residence in rooms provided at the generating station. Mr. J. SMITH, chief assistant accountant of the Barking Council, has been appointed chief clerk at a commencing salary of £190, rising to the authorised maximum of £200 in 12 months.

The Greenock Corporation has increased its electrical engineer's salary from £350 to £450. It was explained that Mr. ROBERTSON had been offered an appointment in Manchester carrying a larger salary, and, at the request of the Electricity Committee, had declined the offer on the understanding that his salary in Greenock would be considered and increased.

Mr. EDWARD GRIME, South Ealing, has been appointed charge engineer at the Southwark electric station. There were 152 applications for the position.

In view of the satisfactory result obtained during the past financial year, the Motherwell T.C. has unanimously agreed to increase the salary of Mr. S. WILLIAMS, the burgh electrical engineer, by £50 per annum.

The Electric Supply Committee of the Hoylake and West Kirby U.D.C. has recommended that Mr. E. F. JONES, engineer-in-charge at Southport, be appointed assistant electrical engineer to the Committee, at a commencing salary of £125.

Our Toronto correspondent informs us that Mr. J. M. CAMPBELL, manager of the Kingston, Ontario, Municipal Electric Lighting Works, "has resigned his position on account of insinuations having been made that he had received commission on machinery recently purchased. Mr. Campbell, who is recognised as one of Canada's leading electrical experts, having built several plants East and West, indignantly repudiated the charges made against him, and at a recent meeting of the Town Council pressed for the names of the persons who had spread such false rumours. As this was not forthcoming, Mr. Campbell resigned his position as a protest, but it is unlikely that the municipality will accept it, and efforts will be made to induce him to reconsider the matter."

Mr. W. H. PATCHELL, Vice-President of the Inst.E.E., M.Inst.C.E., M.I.Mech.E., and M.A.Inst.E.E., who has been engineer-in-chief to the Charing Cross, West End and City Electricity Co., Ltd., for the last 13 years, has just completed a seven-years contract with that company in connection with their City of London extensions. Mr. Patchell is now proposing to establish himself in Westminster as a consulting engineer. He will devote a good deal of his attention to the application of electricity to mines. It will be remembered that Mr. Patchell served on the Home Office Electricity in Mines Committee which inquired into, and reported on, this subject. Mr. Patchell will have offices in Westminster, the address of which will be notified shortly; in the meantime his address will continue to be 60, St. Martin's Lane, London, W.C.

Mr. F. PURSER-FLETCHER was on Saturday last presented with an engraved silver cigarette case by the engineering staff of the Woolwich Borough Electricity Department. He has left to take up an appointment as chief assistant electrical engineer in Chatham Dockyard.

Mr. E. S. A. SMITH has resigned his appointment as canvasser to the electrical undertaking of Battersea. A successor is to be appointed for six months with a technical knowledge of electricity, and to be styled "commercial assistant, electricity department," at a salary of £2 a week, and commission at the rate of 10s. for every 100 8-c.p. lamps connected to the Council's mains as a result of his efforts. Mr. W. F. DUNCAN, temporary shift engineer to the Battersea electrical undertaking, has resigned. A successor is to be appointed permanently at a salary of £104 per annum.

General.—We are asked to state that Mr. J. L. CATEAUX has arranged to leave the British Thomson-Houston Co., Ltd., Rugby, and expects to take up other work at an early date.

From the *Review of the River Plate* we learn that Mr. H. L. RANDOLPH, the manager of the India-Rubber Co.'s Buenos Ayres branch, left for home on the 1st inst. on a short holiday.

Mr. E. T. WILLIAMS, chief electrical engineer to the Sanitary Commissioners of the City and Garrison of Gibraltar, and Mr. H. A. NOTT, deputy electrical engineer, have resigned those positions, having accepted appointments under the Admiralty. Mr. A. S. L. BARNES, assistant electrical engineer, has been promoted to the position of electrical engineer. During the past four years the Gibraltar electrical undertaking has made great advancement, considerable extensions and improvements having been carried out.

NEW COMPANIES REGISTERED.

Cape Town Consolidated Tramways and Land Co., Ltd. (89,037).—This company was registered on June 6th, with a capital of £300,000 in £1 shares, to adopt an agreement between the Cape Town Consolidated Tramways and Land Co., Ltd. (incorporated in 1901), and S. W. Jamieson, its liquidator, of the first part, Messrs. Wernher, Beit & Co., and Messrs. Emile Erlanger & Co., of the second part, and of the company of the third part, and to carry on in South Africa or elsewhere the business of tramway, railway, land, building, and property owners, financiers, electricians, engineers, &c. The first subscribers (each with one share) are:—E. M. Rouse, 28, Messaline Avenue, Acton, W., gentleman; R. P. Nelson, The Hickerage, Writtle, Essex, gentleman; H. G. Broomhall, 13, Gordon Avenue, St. Margarets-on-Thames, gentleman; H. A. Milner, 38, Seymour Road, Hornsey, N., gentleman; W. J. Rose, 97, Seven Sisters Road, N., gentleman; C. Field, 20, Adelaide Road, Brockley, S.E., gentleman; and W. G. Turnbull, 6, Castelnau Mansions, Barnes, gentleman. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are L. Breitmeyer, G. Pauling, R. Littlejohn, Dr. F. Rutherford Harris and H. D. Boyle; qualification, £500; remuneration (except managing director), £500 per annum, divisible.

J. Lomax Kendal & Co., Ltd. (88,987).—This company was registered on May 9th, with a capital of £5,000 in £1 shares, to acquire the business of J. Lomax Kendal & Co., and to carry on the business of electricians, electrical contractors, engineers, fitters, &c. The first subscribers (each with one share) are:—J. L. Kendal, 4, John Dalton Street, Manchester, electrician; Mrs. L. Kendal, 5, the Polygon, Eccles; G. Elliott, Clayton Bridge, Manchester, manager; G. Garner, 17, Alexander Avenue, Levenshulme, cashier; E. Hull, 5, John Dalton Street, Manchester, chartered accountant; J. H. Simpson, 78A, Mosley Street, Manchester, solicitor; and E. Kendal, 372, Chester Road, Manchester, clerk. No initial public issue. Registered without articles of association. Registered office: 4, John Dalton Street, Manchester.

International Telegraphic Appliances, Ltd. (89,123).—This company was registered on June 14th, with a capital of £3,000 in £1 shares (1,000 6 per cent. cumulative preference), to acquire the business of a certain agreement relating to Gell's patents for telegraphic appliances, with a view thereto to adopt an agreement with W. J. van Hoytema, and to develop and turn to account the rights and benefits referred to therein. The first subscribers (each with one preference share) are:—W. J. van Hoytema, The Turrett, Streatham Common, S.W., merchant; A. Strahan, Oakhurst, Ravenscourt Park, W., gentleman; P. W. Gilding, 134, Wellington Buildings, Pimlico, S.W.; A. G. Norris, 54, Minard Road, Catford, S.E., clerk; F. Bedford, 55, Morrison Street, Battersea, S.W., clerk; P. Werner, 57, East Avenue, East Ham, clerk; and F. K. May, 11, Claremont Road, Leyton, E., private secretary. No initial public issue. The preference shares take priority in winding up. The number of directors is not to be less than two or more than five; the first are W. J. van Hoytema (managing director) and A. Strahan; qualification, 50 shares; remuneration of managing director, £150 per annum and 10 per cent. of the profits after payment of the preference dividend; of other directors £50 each per annum.

Pradeau Wheel Syndicate, Ltd. (89,149).—This company was registered on June 15th, with a capital of £5,000 in 2,375 "A" and 2,625 "B" shares of £1 each, to adopt an agreement with C. W. Pradeau, and to carry on the business of electricians, electrical and general engineers, machinists, fitters, founders, smiths, tube-makers, wire-drawers, &c. The "A" shares rank for 47½ per cent. and the "B" shares for 52½ of the available profits of the reserve fund (if and when divided) and of any surplus assets in winding up. The first subscriber (each with one share) are:—J. P. Balfour, 13, Second Avenue, Walthamstow, clerk; Col. H. Harris, Auxiliary Forces Club, Whitehall, S.W.; G. Osborne, 23, Stockwell Green, S.W., clerk; A. L. Bessell, 2, Carlisle Road, N., clerk; A. B. Neel, 21, Maze Hill, S.E., clerk; W. H. Gun, Noycot, Sanderstead, clerk; and E. G. Johnson, Farnham, Crawley Road, Leyton, clerk. No initial public issue. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first; remuneration, £100 each per annum (chairman £50 extra) and a share in the profits.

Electric Sterilising, Carbonising and Stripping Co., Ltd. (89,087).—This company was registered on June 11th, with a capital of £10,000 in £1 shares, to acquire, work, develop and turn to account certain patents, rights and interests relating to the carbonising of wool waste, noils, rags and other fibrous substances, and the sterilisation of anthrax and other infectious diseases, and a process for discharging dyes from textile fabrics. The first subscribers (each with one share) are:—I. Ickringill, Laurel Mount, Keighley, worsted spinner; I. Holmes, Brooklyn, Keighley, brass finisher; A. D. Smith, 7, Castle Road, Keighley, electrical engineer; H. Hey, 2, Ash Terrace, Savile Town, Dewsbury, chemist; H. A. Fleet, 7, Plevna Terrace, Savile Town, Dewsbury, electrical engineer; G. H. Briggs, West Wells, Ossett, rag merchant; and S. Briggs, Dearden Street, Ossett, rag merchant. No initial public issue. Registered without articles of association. The first directors are I. Ickringill, I. Holmes, A. D. Smith, H. Hey, H. A. Fleet, G. H. Briggs and S. Briggs. Registered office, Vulcan Works, Keighley, Yorkshire.

Adamson, Ramsbottom & Co., Ltd. (89,135).—This company was registered on June 15th, with a capital of £5,000 in £1 shares (200 founders'), to carry on the business of manufacturers of and dealers in electric, hand and other cranes, electrical and general engineers, iron and steel manufacturers, makers of tools and railway, hydraulic, electric, pneumatic and other plant, builders of iron structures, &c. The first subscribers (each with one share) are:—E. Adamson, 10, Victoria Road, Waterloo, engineer; Mrs. H. Adamson, 10, Victoria Road, Waterloo; C. J. Adamson, 5, Grosvenor Street, Liscard, salesman; H. Ramsbottom, 191, Lisburn Lane, Liverpool, engineer; J. Adamson, 36, Curzon Road, Southport, manufacturer; A. Adamson, The Nook, Agnes Road, Blundellsands, manufacturer; and Mrs. P. M. Adamson, The Nook, Agnes Road, Blundellsands. No initial public issue; the number of directors is not to be less than three or more than five; the first are E. Adamson and H. Ramsbottom (managing directors) and A. Adamson; the two first-named are permanent subject to holding 30 founders' shares; qualification of other directors, 30 founders' or 100 ordinary shares; remuneration as fixed by the company.

Beeston Accumulator Syndicate, Ltd. (89,105).—This company was registered on June 13th, with a capital of £500 in £1 shares (300 10 per cent. preference), to adopt an agreement with S. Halford and E. Shoals, and to carry on the business of electric storage battery or accumulator manufacturers, chargers of accumulators, electrical engineers, motor and car makers, &c. The first subscribers are:—S. H. Halford, Post Office Square, Beeston, Notts., engineer, 1 ordinary share; E. Shoals, 31, Chilwell Road, Beeston, electrical engineer, 1 ordinary share; Mrs. S. J. Campbell, 31, Chilwell Road, Beeston, 1 preference share; C. Campbell, 31, Chilwell Road, Beeston, builder's manager, 1 preference share; S. Pardy, 16, Lower Regent Street, Beeston, engineer, 1 preference share; B. T. Fletcher, 5, Willow Bank, Beeston, 1 preference share; and E. S. Elliott, 18, Willoughby Street, Beeston, engineer, 1 preference share. No initial public issue. Registered without articles of association. Registered office, Post Office Square, Beeston, Notts.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Hudson & Bowring, Ltd. (75,213).—This company's annual return was filed on April 21st, when 2,710 shares had been taken up out of a nominal capital of £3,300 in £1 shares. £1 per share has been called up on 555, resulting in the receipt of £555. 2,155 shares are considered as fully paid. Mortgages and charges: Nil.

Direct Spanish Telegraph Co., Ltd. (6,732).—This company's annual return was filed on April 12th, when 12,931 ordinary and 6,000 preference shares had been taken up out of a nominal capital of £95,000 in 13,000 ordinary and 6,000 preference shares of £5 each. £94,655 has been received. Mortgages and charges: £30,000 first and £20,000 second mortgage debentures.

Ernest F. Moy, Ltd. (47,408).—This company's annual return was filed on April 25th, when the entire capital of £10,000 in 8,500 ordinary and 1,500 preferred shares of £1 each had been taken up. £1 per share has been called up, resulting in the receipt of £9,992. £8 remains in arrears. Mortgages and charges: £1,240.

CITY NOTES.

British Electric Traction Co.

THE report for the year ended March 31st, 1906, contains the following statements:—

Profit and Loss Account.—The total amount for appropriation, including £14,996 brought forward from last year, is £246,734, after reserving for next account £77,172, being one-half of the profits on the Bombay undertaking and after making a provision of £35,000.

The following amounts in respect of interest on debenture stocks and dividend on preference shares for the year have already been paid or provided for, viz.:—

Interest on 5 per cent. perpetual debenture stock	£72,448
Interest on 4½ per cent. second debenture stock	£20,297
Dividend at the rate of 6 per cent. per annum on the preference shares	£96,862

Leaving a balance of £57,127, out of which the directors propose a dividend at the rate of 3 per cent. per annum on the ordinary shares, requiring £39,990, carrying forward to next account £17,136.

Capital Account.—During the year, £25,000 5 per cent. perpetual debenture stock has been purchased by the syndicate referred to in previous reports. A further amount of £150,146 4½ per cent. second debenture stock has also been called for by the syndicate. The net discount resulting from the above issues amounted to £4,437, and this sum has been charged against reserve.

The subscribed share and debenture capital at March 31st, 1906, was £4,949,969, made up as follows:—£1,333,010 in ordinary shares, £1,614,370 in 6 per cent. cum. pref. shares, £1,473,653 in 5 per cent. per. deb. stock, £528,936 in 4½ per cent. second deb. stock.

Reserve.—The amount standing to the credit of reserve at March 31st, 1905, was £597,899, from which has to be deducted £4,437 mentioned above, and the further sum of £18,325, written off as proposed in the last annual report, in respect of the Wellingborough undertaking. The reserve now stands at £575,137.

Investments.—The aggregate par value of the investments is £4,837,526. They stand in the books at a cost of £4,544,071 (*i.e.*, £293,455 below par value). The majority of these investments, representing a cost of £3,105,846, are revenue earning, and have in the past year yielded a return of £143,652, which is an average of 4⅝ per cent. The comparative figures for the past five years are:—

	1901.	1902.	1903.	1904.	1905.
Revenue-earning investments	£1,437,157	£2,302,391	£2,990,421	£2,852,285	£3,105,846
Yield	£48,683	£97,358	£136,238	£146,164	£143,652
General average yield	3·38 %	4·23 %	4·5 %	5·1 %	4·62 %

These figures show that the aggregate return for 1905-6 was £2,512 less than for 1904-5. This is due to the fact that whilst there has been an increased yield of £12,421 on the investments, there has, on the other hand, been a reduction of £14,933 in the yield by reason of some of the securities having been realised (at a profit) as explained in the last report. A number of the undertakings are still in course of construction or in the initial stages of working, and improvements in revenue may be confidently expected, whilst others have from various causes (which the directors believe to be of a temporary character) not maintained the dividends paid for the preceding year. The aggregate cost of the investments on which no return was earned during the past year is £1,438,225, but the directors believe that the larger proportion of these will in due course yield the average return. With regard to the remainder, the directors are making every effort to improve them. On the whole, the investments are of a progressive character notwithstanding that the local rates and other burdens imposed upon tramway companies in this country are heavy, while the fares which it is permissible to charge are unduly low. In considering the investments it should be borne in mind that there is a reserve of £575,136 available to meet any depreciation of the assets.

Among the undertakings which show improved results, the Auckland Tramways Co. pays a dividend on the ordinary shares of 7 per cent. for 1905, as against 6 per cent. for 1904; the Brush Electrical Engineering Co. pays a dividend of 2½ per cent. on the ordinary shares for the past year, having paid no dividend on the ordinary shares for the previous four years; the Metropolitan Electric Tramways Co. pays a first dividend of 3 per cent. on the ordinary shares. Among the undertakings which make a smaller return than in the preceding year, the Potteries Electric Traction Co. pays a dividend of 4 per cent. on the ordinary shares, as against 5 per cent. for 1904, but places a larger amount to depreciation and reserve fund; the Devonport Tramways Co. pays no dividend on the ordinary shares for the past year, in consequence of lower traffic receipts, due to considerable dockyard discharges, and to increased expenses due to exceptional causes, which have now been removed; the Tynemouth Electric Traction Co. pays 3½ per cent. on the ordinary shares, as against 7 per cent. for 1904, in consequence of reduced traffic receipts as a result of the electrification of the competing railway.

The electrification of the Bombay tramways is being energetically proceeded with, and the business of electricity supply in Bombay is developing satisfactorily. The B.E.T. Co. and the Brush Co. have for some years been engaged in negotiating the concessions and contracts for this important business, and in carrying out preliminary works. The enterprise has involved heavy responsibilities, and during the past year has been successfully established, with the result that the British Electric Traction Co. has recovered the whole of its expenses and received a substantial profit of £154,344, which it has taken in ordinary shares of the Bombay Electric Supply and Tramways Co., one-half of which has been credited to the profit and loss account, and the other half has been reserved to be dealt with in the current year.

The Birmingham and Midland Tramways Co. pays the same dividend as for 1904, although interest has had to be provided on a larger amount of debentures.

The lines promoted in the districts adjacent to Croydon are being constructed and worked by the South Metropolitan Electric Tramways and Lighting Co. The Penge tramways, affording a connection from Croydon to the Crystal Palace, were opened for traffic last Easter, and are producing satisfactory results. Most of the other lines of this company are in course of construction and

some are nearly completed. The electric lighting business of the company is progressing satisfactorily. The company has lately made an issue of £150,000 in 6 per cent. preference shares at par, and £150,000 in 4 per cent. debenture stock at 90. The lease of the Croydon Corporation tramways expired on May 31st last. Schedules given in the report show a large increase in the traffic receipts of the Associated Companies, in which the B.E.T. Co. are interested for the most part as holders of ordinary shares.

The company has many other interests and sources of profit in addition to its investments in the Associated Companies working tramways, light railways and omnibuses. It is interested in several electricity supply undertakings, in the Brush Co. and in other allied concerns. The company also provides financial, engineering and sundry services in the promotion and development of other undertakings. The revenue from these various sources is liable to fluctuation from year to year, but the directors believe that there will continue to be large scope for electrical enterprise, more especially abroad, of which the company will be able to secure a profitable share.

Most of the items in management and general expenses again show reduction upon those of the preceding year, and the total is £54,467, as against £61,436 for 1904-5. The following figures show the proportions which these expenses bear to gross profits for the last three years:—1903-4, 25 per cent.; 1904-5, 20·4 per cent.; 1905-6, 17·2 per cent.

Benefit Funds.—The number of members subscribing to the British Electrical Superannuation Fund has increased to 203, and the contributing companies to 47. The total invested funds on December 31st, 1905, stood at £14,468 16s. The first quinquennial valuation has been made, and certain amendments to the rules to meet points raised by the actuaries have been approved by the contributories. The British Electrical Friendly Society had a membership on September 30th last of 2,142, as against 1,950 at the end of the preceding financial year. The British Electrical Provident Fund, which was established early in 1905, has met with encouraging support. The total number of depositors during the year was 83, and the amount deposited £2,068 12s. 6d., of which £642 19s. 6d. was withdrawn during the year.

Electric and General Investment Co.

The directors' report for the year ended May 31st, 1906, states that there was a gross profit on the transactions of the year of £15,925. After deducting all general charges and the interim dividends already paid on the preference and ordinary shares, and providing for the proportion of the final dividend accrued on the preference shares to May 31st, 1906, there remains a net balance of £6,862; of this sum the directors propose to carry to the contingencies fund £5,862, leaving a balance of £1,000.

The dividends proposed were stated on page 1013 of our last issue.

Hastings and District Electric Tramways Co.

The second ordinary general meeting of the shareholders of this company was held on Thursday of last week at the offices, 1, Queen Victoria Street, E.C., Mr. E. C. Morgan, the chairman, presiding.

In proposing the adoption of the report, the Chairman said that since the beginning of the year the service of the cars had been well maintained, and the number of passengers had averaged about 70,000 per week, and it would probably have been considerably larger had they not been handicapped during the first three months by rather exceptionally unfavourable weather. It was impossible, however, to draw any inferences from the working of the lines in their present unfinished condition. The system comprised 19½ miles of street, of which 14·45 were at the present time open for traffic, the unopened part being, for the most part, the link between the two ends now running, so that they were practically working two systems unconnected with each other. They would readily see that this largely affected the value of the system as an earning instrument. They had also a somewhat peculiar feature to deal with in Hastings. The lines might be divided roughly into two sections, those in use for business purposes, and those which were mainly for pleasure traffic, approximately one-half of their running lines being under each category. That brought them very largely under the influence of the weather, which, when unfavourable, reduced the receipts on their pleasure lines to a minimum. Under these circumstances they considered that the period of five months covered by the accounts, which embraced three winter months were by no means unsatisfactory. Up to the present time they had no data before them to indicate how far the traffic for the five months of the present year, which also included three winter months compared with the five months of last year, the comparison being rendered doubly difficult by the fact that for two months they had been working the increased mileage between St. Leonards and Bexhill, and it was therefore quite impossible to give any forecast as to the future earnings of the system. They felt great confidence, however, that when all the lines were opened and running, they would have a great increase in the receipts, and also an appreciable reduction in the percentage of their expenses. Having regard to the fact that their power station, sub-stations, and that portion of the lines opened on July 31st last, were completed in almost record time, it had been a great disappointment to the directors that the conditions imposed by the Corporation should have caused so much delay in the completion of the system, but it was hoped that within the next three or four months all the lines would be running, and that they would find the earning power of the company satisfactory, as there now seemed every reason to believe. He was not able to say whether they would be able to pay the preference dividend until they had the accounts for the first half of this year. He might, however, tell them that he did not think it likely that they would be able to pay the full dividend, although he thought it was reasonable to suppose that they would be able to make up the balance at the end of the year.

Mr. George Kitchin seconded the motion, and the report was adopted.

J. G. White & Co.

The annual report to February 28th, 1906, states that the result of the year's trading is a profit of £33,610, which is an advance on any previous year's result. The contracts referred to in the previous report were practically completed during the year under review, with the exception of the works at Monte Video and Buenos Ayres, which are still in progress, and in respect of which profit has only been taken into the present accounts for work actually completed and paid for at the date of the balance-sheet. The directors report a very considerable development of the company's business, particularly in the foreign field, and there is very little doubt but that the average of profit will be maintained for the current year. Contracts have been secured and work is in progress as follows:—

For the London County Council.—Reconstruction of the Battersea and Kingsland sections of the Council's tramways.

For the London United Tramways (1901), Ltd.—Reconstruction of the Wimbledon section of the company's lines, &c.

For the North Melbourne Electric Tramways and Lighting Co., Ltd.—Complete construction of tramways in North Melbourne, including power house and cars.

For the Works Construction Co., Ltd.—Reconstruction of tramways in Para, Brazil, including power house and cars.

From the Bombay Electric Supply and Tramways Co., Ltd.—Reconstruction of permanent way, &c., in Bombay.

Buenos Ayres.—Contracts for the Lacroze Electric Tramways, and the Buenos Ayres Central Railway.

For the United Electric Tramways of Monte Video, Ltd.—Reconstruction of the tramways in Monte Video, including power house and cars.

and various other contracts and engineering work, both at home and abroad, the total contract value of work in hand at the date of this report exceeding £2,000,000. The company is interested in various negotiations which it is expected will result in further profitable contracts being obtained.

The company is operating the tramway system of the Dartford U.D.C. with success, and has taken advantage of favourable opportunities of assisting in the development of financial enterprises having relation to its own line of business, and the results have proved entirely satisfactory during the past year. Considerable attention will be given to this branch of the business in the future. The flotation of the additional £50,000 preferred capital was successfully made in July last.

Some changes have been made in the form of the account, it having been considered advisable to show the net instead of the gross profits on contracts. After bringing forward the balance from last year's accounts, £12,679, and deducting the interim dividend paid on the preferred shares at January 1st, 1906, £3,136, there is an available balance to the credit of profit and loss of £43,153. The directors recommend a 6 per cent. dividend on both the cum. pref. and the ordinary shares, also a bonus of 1 per cent. on both classes of shares. Percentage to directors and to staff in accordance with agreements absorbs £2,416. There is placed to reserve £15,000, and £16,357 is carried forward to next year's accounts.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—

Anglo-Argentine Tramways Co.—Further issue of 100,000 ordinary shares of £5 each, fully paid.

Compania de Gas y Electricidad de la Habana.—Scrip certificates (fully paid) for £150,000 5 per cent. debentures.

and to appoint a special settling day in:—

Anglo-Portuguese Telephone Co.—50,000 shares of £1 each, fully paid, Nos. 1 to 50,000; and a further issue of 1,000 shares of £1 each, fully paid, Nos. 50,001 to 51,000, 24,000 shares of £1 each, fully paid, Nos. 51,001 to 75,000, and 25,000 shares of £1 each, fully paid, Nos. 75,001 to 100,000.

Calcutta Tramways Co.—At an extraordinary general meeting held the other day, a resolution was passed increasing the capital to £850,000 by the creation and issue of 30,000 £5 preference shares (5 per cent. cumulative). Extensions to power station and lines are in hand.

Greenwood & Batley.—The directors' report for the past year states that there is a profit of £20,713, making, with the balance brought forward, £26,739. £5,000 has been written off for depreciation of plant, and a dividend at the rate of 5 per cent. per annum on the ordinary shares has been recommended, £6,123 being carried forward.

Indian Electric Supply and Traction Co.—The report for 1905 states that buildings for the boilers, engines and stores, the offices, car-shed and staff quarters are either completed or in a very advanced stage. One boiler is erected and two of the generating sets are in position. The rest of the plant is in course of erection. Owing to a variety of causes it was not possible to commence supply at the date anticipated. Of the underground mains over four miles have been laid, and a start has been made with the laying of the track. The contractors state that the work will be completed by November 30th.

Provincial Tramways Co.—The directors have resolved to pay a dividend of 3s. per share upon the ordinary shares in respect of profits which may be made in the financial year to September 30th next.

MARKET QUOTATIONS.

Wednesday, June 27th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
,, Oxalic	per cwt.	82/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£15	..
a Benzole (90 %)	per gal.	10½d.	..
a ,, (50 %)	per gal.	10d.	..
a Copper Sulphate	per ton	£26	..
a Lead, Nitrate	per ton	£28	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a Potassium Bichromate, in casks	per lb.	3d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	200/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	2½d.	..
a ,, Cyanide	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£160	..
b ,, Wire, in ton lots	per ton	£191	..
b ,, Sheet, in ton lots	per ton	£177	..
b Babbitt's metal ingots	per ton	£43 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	9½d.	..
c ,, Tube (brazed)	per lb.	10½d.	..
c ,, ,, (solid drawn)	per lb.	10d.	..
c ,, Wire, basis	per lb.	9½d.	..
c Copper Tubes (brazed)	per lb.	1/-	..
c ,, ,, (solid drawn)	per lb.	1/0½	..
g Copper Bars (best selected)	per ton	£97	£3 dec.
g Copper Sheet	per ton	£97	£3 dec.
g ,, Rod	per ton	£97	£3 dec.
e ,, (Electrolytic) Bars	per ton	£92	..
e ,, ,, Sheets	per ton	£104	..
e ,, ,, Rod	per ton	£95	..
e ,, ,, H.C. Wire	per lb.	11d.	..
f Ebonite Rod	per lb.	3/8	..
,, Sheet	per lb.	8/-	..
n German Silver Wire	per lb.	1/7	..
h Gutta-percha, fine	per lb.	6/- to 7/-	..
h India-rubber, Para fine	per lb.	5/2	dec.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	49/9	11d. dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£16 15 to £17	5/- to 7/6 dec.
g ,, ,, Sheet	per ton	£18 15 to £18 17 6	5/- dec.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot	£7 5	..
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/3	..
p ,, rolled bars & rods	per lb.	1/1½ to 1/3	..
p ,, ,, strip & sheet	per lb.	1/4	..
o Platinum	per oz.	nominal	..
c Silicium Bronze Wire	per lb.	1/- to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
,, ,, in bars		£15 to £40	..
g Tin, Block (English)	per ton	£178 10 to £179 10	30/- inc.
n ,, Wire, Nos. 1 to 16	per lb.	2/2½	½d. dec.
p White Anti-friction Metals—			
"White Ant" brand	per ton	£46 to £70	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	9d.	1d. inc.
j ,, 6 lea. Flax	per lb.	6d.	½d. inc.
j ,, 8 ply 10 lbs. Russian	per lb.	5½d.	5/16d. inc.
j ,, 10 lbs. Russian, single	per lb.	5½d.	½d. inc.
j ,, 180 lbs. Jute rove	per ton	£18	£7 inc.
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£32	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
j Walter H. Hindley & Co., Ltd.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Llandudno and Colwyn Bay Electric Traction Co.

—An extraordinary general meeting was called for Friday last at Manchester to consider a resolution authorising the sale of the light railway and other assets of the company to the Carnarvonshire Electric Traction Syndicate, Ltd., and authorising the board of directors to complete such sale; and winding up the company voluntarily, with Mr. John Morris, of 33, Brazenose street, Manchester, as liquidator.

STOCKS AND SHARES.

Wednesday Afternoon.

Were the Ancient Mariner to survey the Stock Exchange sea this week, his comment could only be "Flatness, flatness everywhere, Nor any rise to see." Accustomed as years have made us to hear members of the House complain that they never saw such markets in the whole course of their experience, it must be confessed that things are pretty bad at the present time. Consols, despite their recovery from the worst, are still flat, in the face of a reduction in the Bank Rate; foreign politics are unsettling; the public has no confidence in the Stock Exchange, and the effect of the San Francisco calamity is still felt in the absence of support which the insurance companies are in the habit of giving. With which preface, it seems superfluous to remark that electrical shares also lack a vital spark. Also, that the enumeration of steady declines has no more fascination for the writer than it can possess to the reader.

Railway stocks are maintaining their ground, at the lower levels, with a steadiness which some consider a good augury for future development. Central London Ordinary is 86, City and South London 41, and Metropolitan Consolidated 66½, Districts being 25. Firmness in Waterloo and City at 101½ serves as a reminder that the directors might do better for their stockholders and their patrons by supplying cleaner carriages, quicker service at "rush" hours, and better-lighted subways at the Waterloo end. The present failure of the Outer Circle scheme has been without effect upon existing railway stocks.

For British Electric Traction Ordinary to have fallen to a trifle under 5½ is a logical sequence to the issue of the report. Whoever may be taking steps to put a bright complexion upon the document deserves all credit for ingenious arguments, but the market recognises clearly enough the ugly facts disclosed by the figures. It would not be at all difficult to show that the payment of even the pitiful 3 per cent. on the Ordinary shares is a matter of doubtful prudence, considered from the aspect of sound finance, and it is significant of investors' feeling that the 6 per cent. cumulative Preference stand no higher than 8⅞, at which the return is 6⅝ per cent. on the money, or higher than that on the Ordinary shares. Even the First Debenture stock is 3 point down, to 111½. British Westinghouse Preference are about 30s., having parted with some of the slight recovery made a week ago. There is an easing in Calcutta Tramways Ordinary to 8¾, and the new shares are 8⅜. The terrible disaster on Highgate Hill last Saturday made no difference to the quotations for Metropolitan Electric Tramways issues, the Deferred being 3s. 9d., Preference 18s. 9d., and Debenture stock 103. London United Tramways Preference remain dull at 9, which includes the dividend of 5s. due at the end of the month.

What is likely to happen with regard to the South Wales Electric Power Supply Co. it is still impossible to say. The situation is desperate, and only the provision of the extra money can save the concern from utter failure. It is, however, useless to dilate upon the affair until Parliament sanctions the increase of capital, and the proprietors agree to it in general meeting. The Bill has been postponed by the Parliamentary Committee until next Thursday.

The Electric and General Investment Co. declares a dividend, making 10 per cent. for the year, with an additional 5 per cent. out of dividends received on investments. The price of the shares was about 2¾, but upon this showing, it fell to something like 2⅝.

Several unimportant declines in the Telegraph list are to be noted amongst the Eastern group, but the only feature of the market is the drop to 25⅛ in Anglo-American Telegraph Deferred. This is connected with the liquidation in speculative markets elsewhere. National Telephone Deferred fell a shade to 108, but buying of the 4 per cent. Debenture stock is still in progress, and the price is again better at 105. Marconi's are 1¼. An important scheme has been launched for another new telegraph company in Canada, under the ægis of the Grand Trunk Pacific Railway, and five million dollars is said to be the capital of the concern. There is also another undertaking of somewhat similar kind under the wing of the Canadian Pacific Railway.

Electric Lighting prices are almost inanimate for lack of business to test the market. Notting Hill shares are ⅛ better at 14. Citys changed hands at 10¾ on Tuesday, and Bournemouth and Poole 4½ per cent. Preference at 10¼, but the market is without any feature of interest. Charing Cross Debenture are a little lower at 100½, possibly on account of the 5 per cent. City Undertaking bonds, which are now in the market at par. A number of calls upon new issues are due this week. For example, on County of London new Preference, the last £4 a share is payable on Thursday, June 28th, while on Saturday £1 per share is due on Newcastle and District Electric Lighting, Oxford Electric new Preference, and the final £2 on Bruce Peebles new Ordinary. On Friday, June 29th, the Anglo-Argentine Tramway Company wants £4 on its new Ordinary shares.

As the boy comes to call for this "copy," we receive simultaneously a notice that the Cleveland and County Durham Electric Power Company is in a critical state, and that more money is urgently needed. A scheme is defined, to be submitted to a meeting called for this week. There is nothing like doing things in a hurry.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations June 20th.	Closing Quotations June 27th.	Business done week ended June 27th, 1906. Highest	Lowest.	Rise + or Fall —
17,700	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	8 — 3½	8 — 3½	..	..	..
155,600‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	83 — 88	83 — 88	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	23/-	31/-	67 — 69	66 — 68	..	..	—1
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5⅛ %	6 %	113 —114	113 —114	114	113	..
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	⅛ %	25⅞ — 26⅛	25 — 25½	26⅝	25⅛	— ⅛
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..
1,932,856‡	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	97⅞ — 99½	98 — 100	99½	9.⅞	+ ½
16,000	Cuba Telegraph	10	6¾ %	10 %	5 %	5 %	8¼ — 9	8¼ — 9	8⅝	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8¼ — 9	8¼ — 9	..	..	..
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100—103%	100 —103	..	..	..
60,710‡	Direct United States Cable	20	3½%	3 %	3½%	3⅜%	15⅛ — 16	15⅛ — 16	15⅛	15⅜	..
70,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	143 —146	142 —145	144½	143	—1
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	90 — 92	90 — 92	91½	90⅜	..
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	107 —109	107 —109	108½	..	..
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	14 — 14½	14 — 14½	14⅜	14 1/16	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105½ —107½	105½ —107½	107	106	..
800,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 110	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
200,000‡	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5½%	5⅜%	5½%	10⅞ — 11⅛	10⅞ — 11⅛	11 1/16	10⅞	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜ — 14⅝	14⅜ — 14⅝	14 1/16	14⅜	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	39 — 41	39 — 41	39⅜	..	..
42,300	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	57 — 59	57 — 59	58	..	..
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1 — 1⅛	1⅛ — 1⅜	..	..	+ ⅛
72,680	Monte Video Telephone Co., Ltd. Ord. ..	1	3 %	3 %	4 %	..	¾ — 1	¾ — 1	..	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	1⅝ — 1 7/16	1⅝ — 1 7/16	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	110 —112	110 —112	111½	1104	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	108 —110	107 —109	109	107¾	—1
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	12 — 14	12 — 14	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10 — 12	10 — 12	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	99½	98⅛	..
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	103⅛ —105⅛	104 —106	105⅛	..	+ ⅛
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6½%	6½%	7½%	1 7/16 — 1 9/16	1⅜ — 1 7/16	..	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1½ — 1⅝	1½ — 1⅝	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	99 —101	99 —101	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
11,889‡	Reuter's	8	5 %	5 %	5 %	5 %	7½ — 7⅝	7½ — 7⅝	..	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red. ..	100	..	..	..	4½%	103 —106	103 —106	..	..	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	127 —130	..	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7 — 7½	7 — 7½	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —113	110 —113	..	..	..
15,609‡	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9¼ — 10 xd	9¼ — 10 xd	..	..	..
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	Nil	¾ — ¼	¾ — ¼	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	5 %	14½ — 14⅝	14⅝ — 14⅝	14⅝	14 5/16	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..
563,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	104 —107	104 —107	..	..	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	7/16 — 9/16	7/16 — 9/16	..	..	..
24,563	Do. do. 6 % Cum. 1st Pref.	10	7 %*	7 %*	6 %	5 %	6 — 7	6¼ — 7	..	..	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	4½ — 5¼	4½ — 5¼	..	..	..
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..

* Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	8 %	6⅞ — 7⅛	6 13/16 — 7 3/16	7⅛	7	+ 1/16
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅝ — 6⅛	5⅝ — 6⅛	6 1/16	..	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	140 —143	140 —143	142⅝	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 —106	104 —106	..	..	..
800,000	Babcock & Wilcox, 1 to 630,000	1	..	17 %	20 %	20 %	3⅞ — 4⅛	3⅞ — 4	78/9	78/6	— ⅛
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	2¼ — 2⅜	2⅛ — 2⅜	47/6	..	..
40,000	Do. do. 7 % Cum. Pref.	5	Nil	Nil	7 %	7 %	5¾ — 6⅛	6 — 6⅜	6 1/16	6 1/16	+ ⅛
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5¼ — 5⅜	5¼ — 5⅜	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	4 — 4¼	4 — 4¼	..	..	..
900,000‡	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —104	100 —104	..	..	..
800,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	115 —118	115 —118	117	..	..
800,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	107 —110	107 —110	109¾	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	107 —110	107 —110	107½	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	103 —105	103 —105	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	3 %	5⅞ — 6⅜	5 — 6	6⅛	5	— ⅛
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	9⅛ — 9⅜	8⅞ — 9¼	9 1/16	8 13/16	— 1/16
1,415,423‡	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	112 —115	109 —113	..	..	—3
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	93 — 95	92 — 95	..	..	— ½
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6¾ — 7	6¾ — 7	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5¾ — 6⅛	5¾ — 6⅛	..	..	..
600,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	104 —107	104 —107	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1½ — 2	1½ — 1⅔	30/-	28/9	— ½
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	80 — 85	80 — 85	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	5/- — 5/3	5/- — 5/3	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	⅜ — ⅝	⅜ — ⅝	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1½ — 2	1½ — 2	..	..	..
125,000‡	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	97 — 99	97 — 99	..	..	..
125,000‡	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	84 — 86	84 — 86	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3 5/16 — 3 7/16	3 5/16 — 3 7/16	..	..	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5⅝ — 5¾	5⅝ — 5¾	..	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	..	..	..
817,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	106 —108	106 —108	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	103 —106	103 —106	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	8 %	8 %	8 %	8⅝ — 8¾	8½ — 9	8⅝	..	..
32,610	Do. 105,001 to 137,610	5	..	..	..	8 %	8¼ — 8⅜	8¼ — 8⅜	..	..	— ⅛
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	106 —108	105 —108	106	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	10½ — 11½	10½ — 11½	11	10⅜	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5¾ — 6	5¾ — 6	..	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	109 —111	109 —111	..	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %	½ — ⅝	½ — ⅝	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1 7/8 — 1 15/16	1 13/16 — 1 15/16	21/9	21/3	— 1/36
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	98⅜	..	..
1,939,698	Central Londoa Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	84 — 87	85 — 87	86⅜	85	+ ½
630,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	99 —101	99 —101	100	..	..
630,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	74 — 77	74 — 77	77	75	..
1,480,000	City and South London Railway	Stock	3½%	2⅝%	2½%	1½%	40 — 42	40 — 42	41	40⅛	..
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	2½%	2½%	..	1⅞ — 2⅛	1⅞ — 2⅛	..	..	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	96 — 99	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends. ‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations June 20th.	Closing Quotations June 27th.	Business done week ended June 27th, 1906.		Rise + or Fall—
		†	1902.	1903.	1904.	1905.			Highest	Lowest.	
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	..	10 %	..	1⅜ — 1⅞	1⅜ — 1⅞	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	..	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	36/-	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	104 —107	104 —107	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5%	6 %	6 %	13⅜— 14⅜	13⅜— 14⅜	..	..	..
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14⅛— 15⅛	14⅛— 15⅛	..	..	..
63,400	Do. 4 % Debs.	100	..	4 %	4 %	4 %	99½—100½	99½—100½	..	..	..
800,000	Do. 3½ % "A" Debs.	100	..	3½%	3½%	3½%	95 —100	95 —100	..	..	..
800,000	Do. 3½ % "B" Deb. Stock	100	..	3½%	3½%	3½%	95 —100	95 —100	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2½%§	..	1¼— 1⅜	1¼— 1⅜	..	..	..
17,139	Do. "A" shares, 01—017,139	5	Nil	Nil	2½%§	..	2⅛— 3	2⅛— 3	..	..	..
344,023‖	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..
100,000‖	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	..	⅜— ½	⅜— ½	..	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	..	2 — 2⅛	2 — 2⅛	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	88 — 91	88 — 91	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9¼— 9⅝	1⅛— 9⅝	..	..	— ⅛
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	93 — 97	93 — 97	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	3⅝— 4¼	3⅝— 4¼	81/3	..	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10½— 11¼	10½— 11¼	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	100 —101	100 —101	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%	12 — 13	12 — 13	..	..	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5⅛— 5⅜	5⅛— 5⅜	..	..	..
41,978	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	107½	..	..
108,022	Do. do. Scrip. All paid	..	..	..	..	..	107 —109	107 —109	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10 %	10%	5 %	10%	17 — 18	17 — 18	17¾	17	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	1⅝%	1½%	Nil	1¼— 1⅜	1¼— 1⅜	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	4 — 5	4 — 5	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	8 — 8½	8 — 8½	..	..	..
399,930	Do. do. 60,008 to 100,000 (£6 paid)	10	..	8 %	6 %	3 %	4 — 5	4 — 5	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	8½— 9½	8½— 9¼	..	..	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	3 %	¼— ½	¼— ½	..	..	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	¼— 1	¼— 1	18/9	..	..
350,000	• Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	102 —104	102 —104	..	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	5	..	..	6 %	6 %	4⅞— 5⅛	4⅞— 4⅛	..	..	..
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	7 — 8	7 — 8	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	7⅞— 8⅛	7⅞— 8⅛	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	100 —103	100 —103	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	32 — 34	32 — 34	34	33	..
150,000‖	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	102 —104	102 —104	..	..	..
8,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	94 — 96	94 — 96	94⅛	..	..
540,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	100 —103	100 —103	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	6⅔%	3 %	Nil	Nil	1¼— 1⅜	1¼— 1⅜	..	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	Nil	Nil	2⅜— 3¼	2⅜— 3¼	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	78 — 83	78 — 83	78¾	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5⅛%	4 %§	5⅛— 5⅜	5⅛— 5⅜	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8 — 9	8 — 9	..	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅞— 8¼	7⅞— 8¼	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	100 —103	100 —103	101½	101	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	4 — 5	4 — 5	90/-	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅜— 4⅞	4⅜— 4⅞	87/6	..	— ⅛
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅞— 4⅜	3⅞— 4⅜	..	..	..
40,000	Do. do. 1903	5	..	4½%	4½%	4½%	3⅞— 4⅜	3⅞— 4⅜	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —103 xd	99 —102 xd	..	..	..
44,436	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	6 %	5¼— 5⅜	5¼— 5⅜	5⅜	..	..
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	108 —110	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	10¾— 11¼	10¾— 11¼	11	10⅜	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12 — 13	12 — 13	..	..	..
400,000‖	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —103	100 —103	101¼	100⅜	— ½
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	2⅛— 3⅛	2⅛— 3⅛	..	..	..
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8 — 9	8 — 9	..	..	..
80,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	11⅛— 12⅛	11⅛— 12⅛	12	..	..
400,000‖	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	109 —112	109 —112	109¾	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —104	101 —103	102	..	— ½
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	5 %§	3⅜— 4¼	3⅜— 4¼	..	..	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	4⅜— 5	4⅜— 5	..	..	..
820,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	103 —106	103 —106	104	..	..
10,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	5½%	5⅛— 5⅜	5⅛— 5⅜	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5⅛	5 — 5⅛	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
13,000	Hove, 1 to 13,000	5	..	8½%	8½%	9 %	8 — 8½	8 — 8½	..	..	..
10,000	Do. New (£6 10s. paid)	£3	..	8½%	8½%	9 %	7 — 7½	7 — 7½	..	..	..
37,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —101	98 —101	..	..	..
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	98 —101	98 —101	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12%	12 %	10 %	10 — 11	10 — 11	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	4 %	2 — 2⅛	2 — 2⅛	..	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	5⅜	..	..
874,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	97 —100 xd	97 —100 xd	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %	8 — 9	8 — 9	..	..	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5⅜— 5⅝	5⅜— 5⅝	..	..	..
220,000‖	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	110 —114	110 —114	..	..	..
250,000‖	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	5	..	8 %	8 %	8 %	7⅞— 8⅛	7⅞— 8⅛	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	5	..	5%	5 %	5 %	5⅝— 6¼	5⅝— 6¼	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½%	13 — 14	13½— 14½	..	..	+ ½
64,000	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6¾%	7 %	7 %	6⅞— 7⅛	6⅞— 7⅛	6¹⁄₁₆	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	10½— 11½	10½— 11½	11⅜	11¹⁄₁₆	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000‖	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	96 — 98	96 — 98	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	2¼— 2⅜	2¼— 2⅜	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½%	8 %	4 %	4 %	2¾— 3¼	2¾— 3¼	..	..	..
103,700	South Met. Elec. Lt. & Power (Ord.	1	Nil	Nil	Nil	2½%	⅞— 1	⅞— 1	..	..	..
85,368	*(Late Blackheath and Greenwich* 7 % Pref.	1	Nil	7 %	7 %	7 %	1⅜— 1⅝	1⅜— 1⅝	..	..	—
148,292	*Dist. E.L.Co.)* (4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	3 — 3⅛	3 — 3⅛	..	..	..
30,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4½— 5	4½— 5	..	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	100 —102	100 —102	101¼	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14 %	13 %	10⅛— 11⅛	10⅛— 11⅛	10⅝	10⁵⁄₁₆	..
28,151	Do do. 4½ % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅝— 5⅞	5⅝— 5⅞	5½	5⁵⁄₁₆	..
	(Originally 5 %—Red. to 4½ % from 31st Dec., 1905.)										

Shares not officially quoted :—Mackay Companies, ord., 76½—77½ Pref. 76—77.
† Unless otherwise stated all shares are fully paid. § Interim dividends.

(Bank rate of discount 3½ per cent. (June 21st, 1906).

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING MAY, 1906.

The records of electrical exports and imports during the month of May indicate a decided improvement over the previous month.

The value of the exports amounted to £138,461; of the imports, to £132,036; and of the re-exported foreign and colonial material, to £8,307.

These compare with £109,619, £127,969 and £7,387 respectively, the totals for the month of April; and though the imports are some ten thousand pounds higher, the other totals show but slight variation from those recorded in May, 1905.

As far as our records go back (some 16 months), but slight improvement is noticeable in the exports, although an upward tendency is shown in the case of the imports.

Of individual items, the exports of electrical and electrically-driven machinery show an improvement over their previous excellent total—amounting this month to some £63,000, which compares with some £29,000 the value of such machinery imported. A general improvement is noticeable in many other items of both exports and imports—the latter in particular showing a jump of from £30,000 worth of Telegraph and Telephonic material in April to £36,000 worth approx. during the month under review. Of the latter total, Belgium contributes the abnormal amount of £23,387 worth.

During the month a small export of tramway material was recorded, none being declared in the previous month.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Country receiving exports and importing.	Electrical goods and appliances.	Electrical cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telegraph and telephone material and electric bells.	Electrically-driven machinery.	Tramways apparatus and materials.
	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark	70	2,697	315	3	2	5,085	...	...	...	31	15
Germany	18	...	31	...	8	231	2	...	2	...	...
Netherlands	24	1,289	670	...	...	199	3	...	...	...	...
Dutch Borneo and Java	...	14	6	14	...	...	...	...	3	...	...
Belgium	...	...	146	5	74	113	...	...	372	...	...
France	77	...	10	9	57	25	241	...	...	...	...
Portugal, Madeira and Portuguese Africa	292	235	191	140	115	1,297	17	...	29	16	...
Spain and Canary Isles	...	534	79	...	...	2,714	2	...	...	...	...
Italy and Austria-Hungary	63	...	...	...	35	200	...	...	...	...	...
Greece, Bulgaria and Roumania	...	...	...	...	...	946	...	...	...	450	...
Egypt	318	60	234	42	...	520	10	...	67	61	...
Tunis and Morocco	...	...	...	...	8	...	...	...	...	20	...
China and Siam	369	2,558	306	18	14	1,491	102	...	25	...	...
Japan	5,876	4,667	386	3,787	1,327	3,864	...	...	66	615	...
U.S.A., Philippines and Cuba	80	...	32	425	115	453	...	...	25	...	...
Mexico, Colombia, Peru and Uruguay	46	...	...	...	54	...	4	...	...	9,410	115
Chili	224	111	956	65	...	1,074	...	...	...	...	...
Brazil	1,032	22	113	122	...	961	119	12	...	660	...
Argentine	2,965	1,139	26	138	153	5,406	186	...	1,440	3,290	417
Channel Isles, Gibraltar and Malta	149	116	35	19	35	45	3	...	93	...	284
British West Africa	80	...	12	28	...	26	...	...	...	...	...
Cape of Good Hope	734	2,406	87	594	167	1,679	97	...	...	32	...
Natal	2,914	4,403	577	713	294	7,321	88	...	...	...	...
British East Africa, Mauritius and Aden	6	38	35	...	...	688	66	...	...	61	...
India	3,112	1,396	506	320	1,466	3,071	539	610	184	1,663	...
Burmah	92	...	52	17	...	1,083	9	...	8	...	...
Ceylon	91	150	143	11	93	97	10	...	...	278	...
Straits Settlements, Fed. Malay States and Sarawak	184	47	519	44	128	55	14	209	...	4	256
Hong Kong	8	59	194	...	...	241	...	...	31	1,300	...
West Australia	330	124	47	168	51	524	175	...	10	...	...
South Australia	70	187	...	...	...	...	55	...	14	...	...
Victoria	370	555	709	84	36	725	17	...	...	...	...
New South Wales	3,756	841	133	735	...	1,338	174	...	60	...	...
Queensland	66	...	12	...	...	...	...	...	16	...	...
Tasmania	21	...	...	...	5	50	...	...	...	...	...
New Zealand	612	172	622	35	51	2,715	195	...	39	627	...
Canada and Newfoundland	127	1,839	172	17	...	44	...	...	...	...	...
British West Indies and British Guiana	34	3	7	26	...	30	...	...	...	...	...
Total, £	24,210	25,562	7,363	7,579	4,288	44,311	2,128	831	2,484	18,518	1,087

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£		
Norway, Sweden and Denmark	117	231	10	136	...	740	133	8	10,837	...	...
Holland	1,772	5,932	114	3,999	27	1,067	149	6,934	36	...	...
Germany	3,888	14,378	1,011	525	408	9,638	242	497	...	...	...
Belgium	2,276	1,989	72	1,919	...	3,438	45	1,050	23,387	...	...
France	1,839	5,803	1,360	739	1,348	1,635	435	3,431	992	...	...
United States	1,850	665	1,242	372	...	12,468	75	77	468	...	...
Canada	...	...	...	10	...	..	...	...	...	...	...
Italy	...	142	...	...	...	...	...	...	...	...	...
Victoria	...	...	...	...	...	80	...	...	...	...	...
Total, £	11,742	29,140	3,809	7,700	1,783	29,066	1,079	11,997	35,720	...	...

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	
Various countries, mainly as above	2,179	216	199	329	37	4,892	22	347	969	4	...

Total Exports:	Total Re-Exports:	Total Imports:
£138,461	£8,307	£132,036

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

RAPID METHODS FOR PRODUCING ELECTROTYPES.

By SHERARD COWPER-COLES.

(*Continued from page* 952.)

Construction and Position of Dynamo. — The dynamo should be placed as near the depositing vat as possible, as the conductors required to carry the amperage, which is usually large, are of considerable weight. At least 1 sq. in. of section of conductor should be provided for every 1,000 amperes, and where contacts have to be made, the allowance should be even greater. Fig. 16 shows a compact plant, provided with an air compressor for agitating the solution, but in practice it is found more convenient to place the dynamo at such a distance that the vat can be approached from all sides. The dynamo should be shunt-wound, or separately excited by a small dynamo provided for the purpose or direct from the mains which supply electric current to the motor, or especially when the vats are worked in series, compound-wound, which means the introduction of a few turns of series coils into the field, connected to an independent source of supply, so that the machine

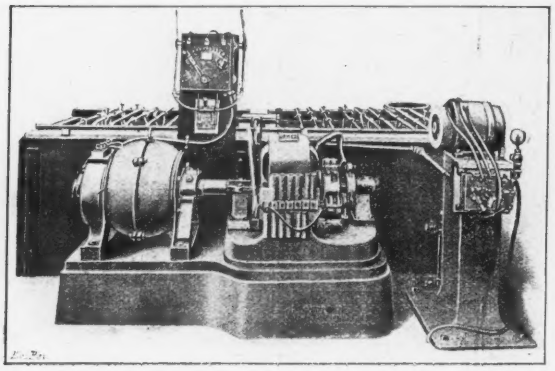
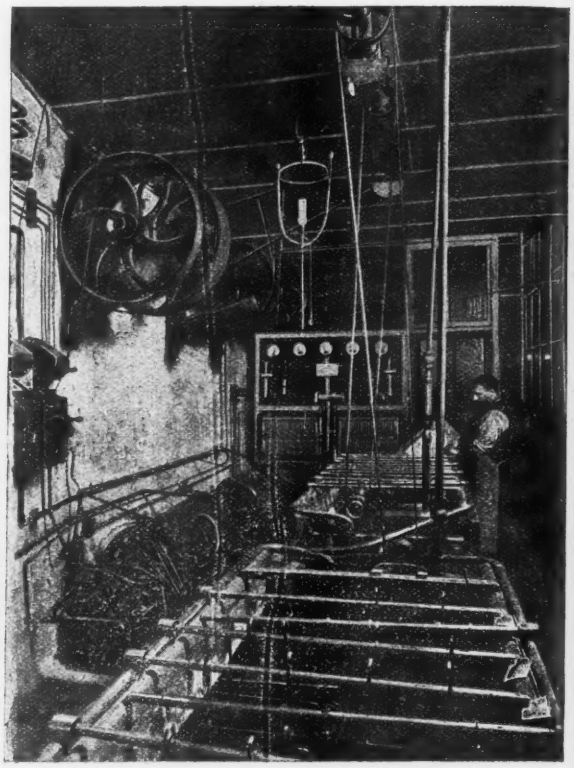


Fig. 16.



Motor Dynamos. Switchboard. Agitators (in centre).

Fig. 18.—The Battery Room.

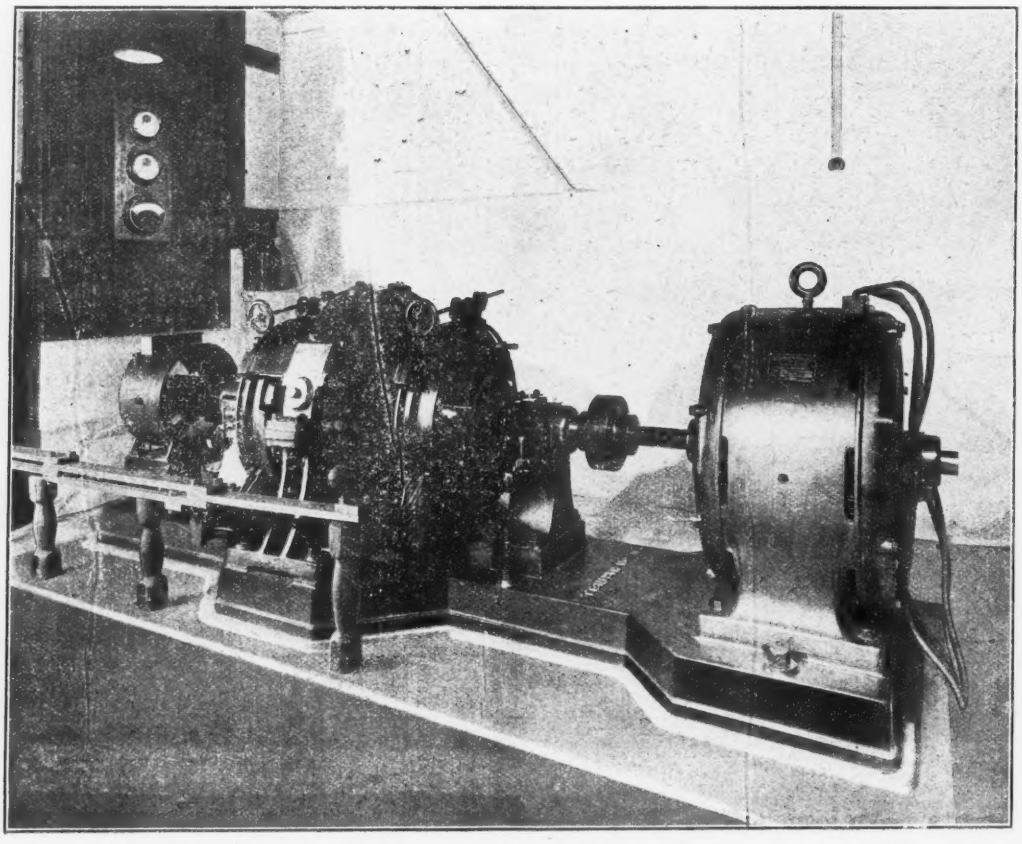
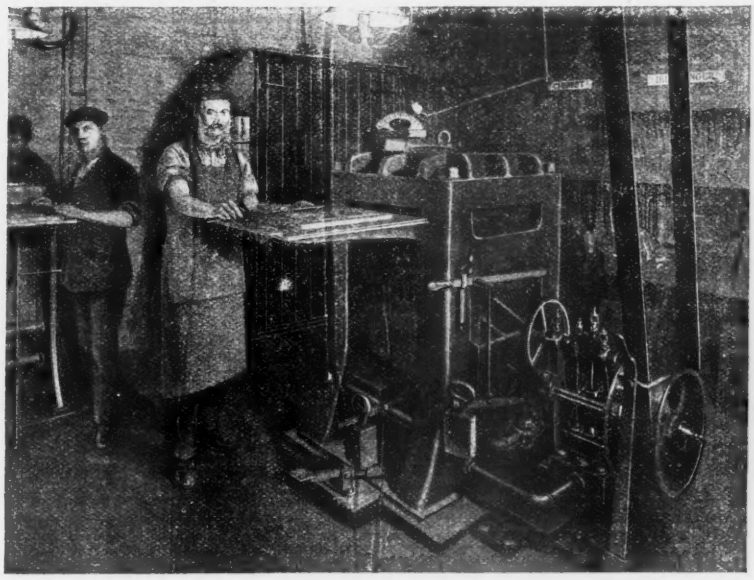


Fig. 17.—6,000-Amp. Depositing Dynamo Separately Excited.

responds to any change of load and maintains a constant voltage. Fig. 17 shows such an arrangement. On the right-hand side is the motor worked by an alternating current; in the centre is a dynamo giving 6,000 amperes at 6 volts, and on the left is a small dynamo of comparatively high voltage for exciting the fields. Dynamos constructed for electrotyping should have metallic brushes, not carbon, which involves a contact loss of about 1 volt; if the dynamo is constructed to give 4 volts only this means a loss of 1 in 5, or 20 per cent. of the total power consumed.



Hand Moulding Press. Warming Cabinet. Power Moulding Press.

FIG. 18A.—THE MOULDING SHOP.

Accumulators are a valuable adjunct, although they are not a necessity, especially when the rapid process of electro-depositing is used, but, on the other hand, it enables work to be left in the depositing vats all night without running the motor-transformer.

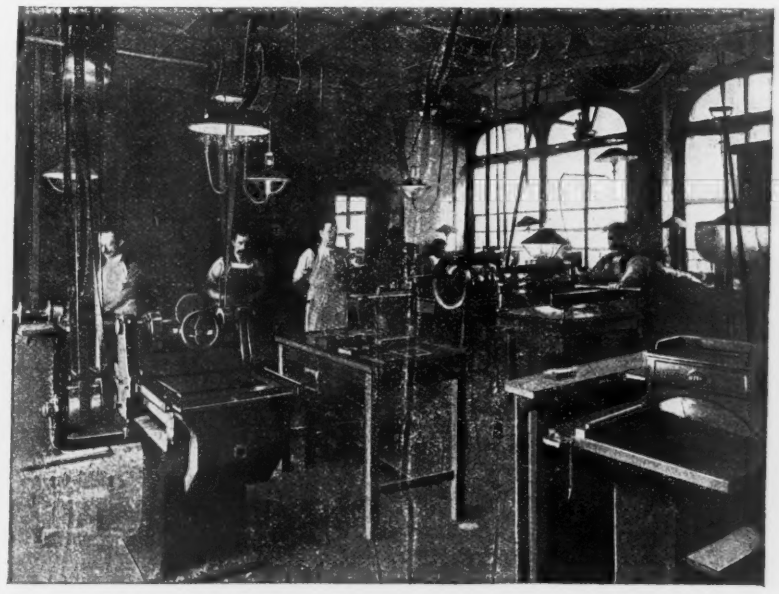
Comparison of Quick and Slow Methods of Electrotyping.—To arrive at the advantage to be gained as regards the comparative working costs of the slow and quick methods of electrotyping, and comparing the advantages of each system, five points have to be taken into consideration—(1) the cost of the plant; (2) the cost of working; (3) the rapidity with which the work can be carried out; (4) the saving in labour; and (5) the class of labour required to be employed.

The only advantage obtained by the adoption of the slow process of electrotyping is that the first cost of the plant is somewhat less than in the case of a rapid electrotyping plant, for the reason that the dynamo is smaller although the vats are larger, but the vats are a comparatively cheap item as compared to the cost of the dynamo. The usual time required to grow a shell of a page of type and cuts intermixed, with an area of a little over a square foot, has, on an average, been from two to three hours, according to the system of working and method of agitating the solution. When the solution is not circulated, and the time employed is not excessive, the shells are often a mere film of copper, losing the sharpness of the work before the first 1,000 impressions have been taken, which is due to, firstly, too thin a shell, secondly, poor quality of the copper.

One of the great advantages of the quick process, is that thick shells can be obtained in 10 or 15 minutes, the copper being hard and tough. Another advantage is that the floor space occupied by the quick process is about one quarter of that required for the slow process, and if any shell should chance to be unsatisfactory, another one can be made in a few minutes.

Composition Moulds.—The moulds employed for the slow process of electrotyping are usually composition made from a mixture of beeswax as follows:—For 10 lb. of material, 9 lb. of commercial beeswax are melted, into which 1 lb. of Venice turpentine is stirred, and finally 5 oz. of the very finest plumbago; the melting point of this composition is about 150° F. Each electrotyper generally has his own special composition. Moulds are also made of gutta-percha alone, or mixed with lard or deer fat, which readily takes a conducting coating of black lead. Gutta-percha shrinks whilst cooling, and, therefore, a considerable pressure is required just before it hardens.

Other electrotypers add an ozokerite compound to the moulding wax, the composition being varied with the season of the year, according to the temperature; 1 pint to 1 quart to each 50 pints of wax is recommended until the wax is soft enough. Ozokerite, which is a dark mineral wax found in Austria, with a high melting point somewhat resembling paraffin wax, is used to a considerable extent in America. This wax should always be melted by means of steam, not over gas or a fire, otherwise it becomes brittle. When it becomes too stiff for use, it is thinned with turpentine or crude oil, or special composition supplied for the purpose



Beveller. Shaving Machine. Saw Bench. Rougher Router. Edge Trimmers.

FIG. 18B.—THE FINISHING SHOP.

Ozokerite is sometimes combined with Venice turpentine to make it more fluid.

Composition moulds are generally black leaded, and the surface rendered a better conductor by dusting with iron filings and flooding with copper sulphate to get a coating of copper by the interchange of the two metals, or the mould is flooded with a solution of phosphorous and alcohol.

For taking half-tones, it is advisable, instead of dusting

the surface of the wax over with plumbago, that the surface of the wax should be highly polished before the impression is taken. This will give a good result, and minimise the risk of spoiling the mould by the black-leading process, which is always detrimental to the best work, due to the liability of rounding the dots in the tint, which should otherwise be square.

The two greatest obstacles in the reproduction of half tones are first the excess of black lead left on, and the thickness of the coating that is put or spread over the surface of the wax before the mould is taken. If turpentine is used in cleaning formes, it is apt to hold the black lead and reduce the detail in the shadows; benzole should be used instead of turpentine. The wax compositions should be poured thin on the cases, so as to minimise the shrinkage.

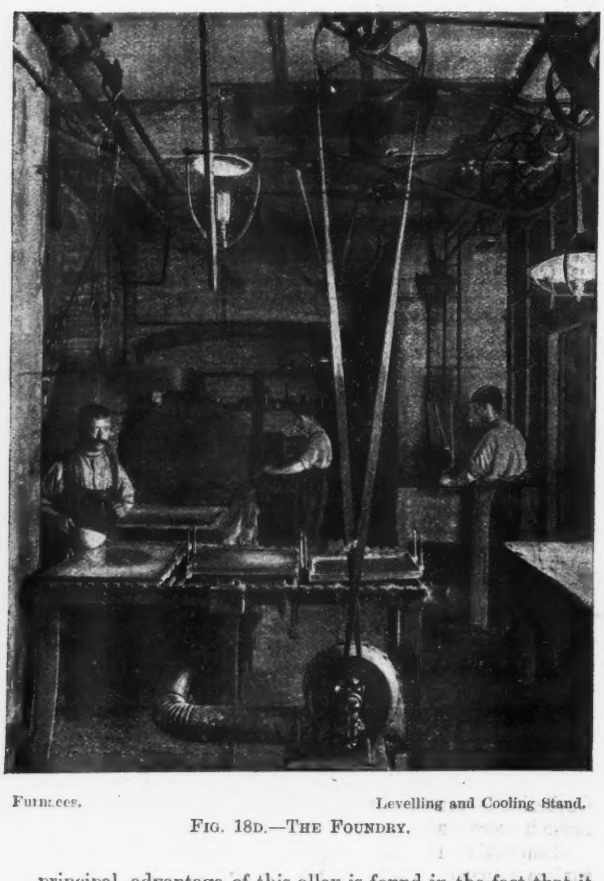
No composition moulds are satisfactory for rapid electrotyping, for the reasons already given—namely, that it is essential to have the electrolyte hot, and, therefore, for rapid processes metal moulds should be employed.

Metal Moulds.—Metal moulds composed of lead alloys were amongst the earliest used when electrotyping was first introduced; but it was found difficult with the appliances then available to get good half-tones. An alloy used to some extent at one time, was composed of 1 lb. of lead, $\frac{3}{4}$ lb. of tin and $1\frac{1}{2}$ lb. of bismuth, which melts at the temperature of boiling water, and assumes a plastic condition just before setting, at which time the impression should be made. The principal advantage of this alloy is found in the fact that it expands after the cooling, and therefore takes a very sharp impression. Lead moulds were found to be defective on the shadows, and alterations took place on the tone gradation in half-tones, so wax moulds came into almost universal use. Experiments have been made with wax moulds faced with metal foil such as lead and copper, but, so far, they have not proved successful. Dr. E. Albert has recently introduced a process of metal moulding which consists of laying on the forme or cut, a sheet of lead about 2 mm. thick, and on top of it a number of sheets of soft paper. He applies pressure in a special form of hydraulic press, so arranged that after giving a squeeze the pressure can be released quickly, the bed shifted by a small amount, and another squeeze given, which is repeated several times. It is claimed that by this means less pressure is required, and a more perfect result obtained than if one dead squeeze was given as in wax mouldings. The lead mould is tacked on to a board, and is ready without any further treatment for placing in the electrotyping vat.

Another method is that of Gustav Fisher, who has patented a modification by which he can dispense with the soft backing by scouring the lead with V-shaped grooves, so that it forms pyramids, see fig. 19; he claims that this allows the lead to bend itself to the hollows of the formes. The advantages of a metal mould are that the copper deposit takes quickly owing to improved conductivity, and when completed the shell is easily stripped off without damaging the mould, so that it can be used again for duplicates. The temperature of the solution can be raised, and consequently the voltage reduced for a given amperage, and a higher current density employed, as already stated.

Wax Pots and Case Filling and Cooling Tables. Wax Shaving Machine. Metallising Troughs. Blackleading Machine.

FIG. 18C.—WAX CASE FILLING AND BLACKLEADING.



Furnaces. Levelling and Cooling Stand.

FIG. 18D.—THE FOUNDRY.

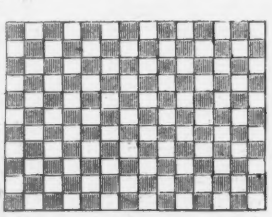


FIG. 19.

Description of a Modern Electrotyping Plant.—Figs. 18, 18A, B, C and D show a modern electrotyping plant, which has recently been erected at Messrs. Spottiswoode and Co.'s works, where all the latest resources of electricity are employed, so that, under special circumstances, they are able

to deposit shells in 15 or 20 minutes, whilst it is claimed that the time required for regular batches of work does not exceed 40 or 50 minutes. Hitherto the recognised time has been from three to four hours. The plant consists of two lead-lined vats each 6 ft. × 2 ft. 6 in. × 3 ft., and are capable of holding 48 cases, or about 60 sq. ft. of work. Each vat requires about 100 amperes, and is fitted with an air agitator, see fig. 18, and also provided with steam pipes for keeping up the temperature in cold weather, besides a pump for emptying. The electric current is applied by two motor-generators, each with an output of 550 amperes. The dynamos are so arranged that one can be worked at a time, each supplying a separate vat, or both can be coupled in parallel by a switching device, which makes them run practically as one machine, giving 1,100 amperes. It is thus possible to run one or two together, each supplied from a separate dynamo, or the two tanks can be run in series, a current density of 120 amperes per sq. ft. being often employed.

To facilitate the description of the various apparatus used for the rapid production of electrotypes, the author has classified them under the following headings :—

Classification of Various Systems—

1. The electrolyte circulated and agitated.
2. The electrolyte circulated only.
3. The electrolyte agitated only.
4. The electrodes moved.
5. The electrolyte circulated and filtered.
6. Impingement processes.
7. Air agitation only.

(*To be continued.*)

THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

On Wednesday morning last week this Association continued its meetings, in the Wharncliffe Rooms of the Hotel Great Central. Mr. Fedden and Mr. H. Collings Bishop read brief abstracts of their respective papers, the first having for its title "The Commercial Development of Electricity Undertakings," and the other only differing by the substitution of the word *Electrical* for Electricity.

Messrs. Newington, Hoadley, Sowter, Alderman Smith (Liverpool), Bailie Willock, Wilmshurst, Hawtayne, Councillor West (Coventry), Long, Brydges, Snell, Alderman Coates (Hanley), Shaw, Acheson and Pearce took part in the discussion, but as Mr. Snell's paper on "Relative Economies of Electrical Supply from small local stations and from Power Companies" had still to be dealt with, Messrs. Fedden and Bishop had no alternative but to state that they would send in their replies to the proceedings of the Association.

We deal with the subject, as with others, in the manner we have generally adopted at these gatherings, that is, by commenting on what we consider the salient features brought forward.

Push and Electric Light.

Something of the character of the religious "revival" meetings should attach to the conferences of the Municipal Electrical Association, particularly in so far as they may be calculated to disperse with every member stirred to more strenuous efforts in the long and arduous competition to which electric lighting has been so unexpectedly subjected. We say "unexpectedly," because it is useless to deny that most of the companies and municipalities engaged in the supply of electricity have met with a much more vigorous resistance to extinction on the part of their rivals than was anticipated. Now that their officials review the progress they have made, there is no difficulty whatever in pointing to the particular weapons and defences with which the gas industry has stood at bay successfully for so many years after appropriate epitaphs were being composed in anticipation of its early decline. The clever exploitation of "incandescent" improvements and the institution of popular systems of heating and cooking have done much to counteract the hygienic and aesthetic claims of electric lighting; but the most powerful bulwark of the older industry has been simply the fact of its being an accepted domestic convention. To the house builder as well as to the housekeeper, gas pipes come as naturally within first principles of domestic economy as water taps and drains. In other words, the gas industry has still the advantage of the momentum it gained in pre-electric generations, and its directors and officials, with enormous financial resources behind them, have found means of proving that nothing succeeds like success.

So much being admitted, what is the true course of aggressive policy that will enable the electrical undertakings to extend their businesses more rapidly in the face of these obstacles? Probably because a complete answer to this question is so earnestly awaited, the M.E.A. papers of Mr. S. E. Fedden and Mr. H. Collings Bishop on the "Commercial Development of Electricity Undertakings" were regarded by the majority of the members as the most important to be discussed. Examined in detail, they enumerate various considerations which affect the progress of a municipal electric lighting business—questions of price and method of charging, the sale and renewal of lamps, free wiring, canvassing, advertising and so forth—but, in our opinion, they fail to state in broad terms what should be the means to be adopted by the electrical industry as a whole to direct public opinion. While it is, of course, essential that the officials of each undertaking should do their best in their locality to bring in new consumers, we are inclined to feel that something more than this guerrilla warfare might be attempted with fair promise of successful results. All readers of the popular daily Press are made aware of the so-called victories of high-pressure gas in the lighting of public thoroughfares and railway stations, and although it is the fact that the advance of electricity has turned out thousands of street gas lamps in the past few years, yet the advertising methods of gas directors produce quite the contrary impression. We should like to see some combination of forces which would aim at impressing public opinion throughout the country with a deeper sense of the unwholesome and dangerous features of gas lighting, and with the progress made by its competitor.

Narrowing the field to examine merely the best forms of local effort, we are of opinion that more use might have been made of the weight of money in numerous instances. The policy of many towns has been equivalent to what gold miners call "picking the eyes out of the mine," that is to say, the classes of consumers easiest to secure have been regarded as almost sufficient in themselves to justify the concern in regarding itself as a prosperous institution, without looking ahead to the development of the lower grade ore represented by humbler shopkeepers and householders. Having no hungry shareholders to appease, and regarding depreciation with unconcern, it would undoubtedly have been better for the municipalities not to distribute so-called "profits," but to use their surpluses in the extension of business. They should have spent the money rather on advertising on free wiring, on the reduction of prices, or in other ways suggested now by the members of the M.E.A. at the conference. As it is, funds are somewhat low in many towns, and committees have no margin for meeting expenditure of this kind. Otherwise, for every electric light undertaking that can afford the outlay, there could be no better time than the present for forcing the pace by the judicious expenditure of money on bringing the advantages of electric lighting closer to the people.

Undoubtedly it is the wiring question that is the principal obstacle. Gas pipes are still put into new houses as a matter of course, and in older houses the tenant is very reasonably reluctant to incur the cost of installation, which is logically a matter for the landlord. We doubt whether property owners have been approached in the right way or with sufficient persistence in most towns. It is incontestable that the wiring of a house for electric light increases its rent value, and there are probably many cases in which the tenant would readily agree to a slight increase in consideration of this being done by the owner, which would, of course, be much more acceptable to the lighting authority than the ordinary method of "free wiring." That authority might, however, make easy terms for the landlord, if only to set a fashion.

We are reluctant to believe that the adoption of the electric light turns upon the question of a few shillings more or less on the quarterly bill, or upon the "maximum demand" or any other system of charging. Gas is more expensive than oil, but is consumed in preference. Why? Merely because it is more convenient. Electric light is, of course, far more convenient still, and many people recognise it as such who still go on using gas. The key to the position is the spread of a feeling that electric light is more "respectable." We are afraid that the ordinary householder decides to risk the perfectly well-known hygienic objections to gas, and will not take the trouble to change; but if by energetic methods some of his less indifferent neighbours are captured by the canvasser, he will become gradually dissatisfied with his domestic illumination. The policy then is to force the pace by the expenditure of a certain amount on a special campaign to secure representative tradesmen and householders, who will not, perhaps, of themselves recoup the outlay, but will give a stimulus to future business; or, in other words, will produce something in the nature of an equivalent to that momentum, which we have referred to as one of the most valuable assets of the gas industry.

Letting off Steam.

With the preliminary section of Mr. Walter A. Vignoles's paper on "Efficiency of Steam Plant" we deal on another page. Here we touch upon the more lengthy portion, which considers the coal consumption of an electricity works in two parts:—(*a*) Boiler house economy; (*b*) plant economy.

In regard to the former, it is first pointed out that the flue gases should contain a satisfactory percentage of carbon dioxide, to effect which end the boiler setting should be air-tight. Information from station engineers who have used CO_2 recorders is solicited; for this we may refer the author to previous M.E.A. proceedings.

At Grimsby mechanical stokers are in use, the author reporting that the underfeed type works satisfactorily. The repair costs for the past two or three years have averaged £7·35 per boiler per annum. This works out at 2·0d. per ton of coal burnt by the stokers, and includes substituting steel worms for those originally fitted. Interest and capital cost works out at 5·2d. per ton of coal burnt. Apparently the boilers are never pressed, as tests at the works show that the boiler efficiency is about the same during the daytime as during heavy load. The practice is to work each boiler at a moderate load, and to add more boilers as the load rises.

In regard to plant economy, the author considers that in this part of the subject we have to consider the pounds of steam used per useful unit generated at the terminals of the dynamos. This must include all steam used for auxiliaries of all kinds, such as feed pumps, forced draught engines, condensing plant, &c.; it must also include the steam condensed in the range and separators, discharged from traps or drains, &c., and if the station has electrically-driven auxiliaries, the current supplied to these must be deducted from the total units generated, and the useful units generated alone considered.

The total steam used in the station can be divided into three parts—

(*a*) The amount of steam supplied by the boilers when the plant is ready to generate current, but without actually giving a supply. This includes—

1. Leaks from blow-down pipes, scum cocks, separators on boilers, &c.

2. Leaky drains on steam pipes, condensation in the ranges, blown-through separators, &c.

3. Steam required by condensing plant maintaining a vacuum in the exhaust pipe.

4. Steam required for feed pumps and any other auxiliaries it is necessary to run if the station is working at light load.

5. Steam required for one engine at light load, or supplying the current required for auxiliaries as above.

(*b*) The extra steam required for auxiliaries to deal with the load.

(*c*) The extra steam required by the engines to deal with the load.

The author made numerous tests, a year or two ago, of the amount of water pumped into the boilers per hour at various loads on the plant—some short tests of 2 hours' duration, others of 12 and 24 hours—and on plotting the water per hour against the average load, it was found that the points lay fairly well on a straight line, this line starting at a point above zero, indicating the minimum steam consumption. Fig. 1 shows this, and dotted lines have been added to show how the total can be divided as set out above. If the steam used at no load be deducted from the total, the steam per KW.-hour works out at 33·7 lb., and the total water to boilers per KW.-hour is 70 lb. at 50 KW., average load; about 52 lb. at 100 KW., and 37·5 lb. at 500 KW. This curve is very useful, and is accurate as long as the plant is maintained in the same condition; if the average load on the plant is known for any period—say a day or a week or a month—the curve shows what the average steam consumption per hour should be. If such a curve be made for a station when the plant is new, it forms a basis for comparison later on to show if the steam consumption is increasing from any cause.

A subsequent test showed that the steam consumption had increased, the points of the second curve lying above those of the first curve. The steam consumption at the present time is analysed as follows:—

(*a*) Stand-by losses, 2,450 lb. per hour, excluding 350 lb. per hour unaccounted for.

(*b*) Extra steam required by engines to deal with the load, 5·1 lb. per KW.-hour.

(*c*) Extra steam required by engines to deal with the load, 31·6 lb. per KW.-hour.

(*d*) Unaccounted for, 350 lb. per hour plus 4·1 lb. per KW.-hour.

These figures show that the increase in the steam consumption is largely due to wasteful auxiliaries.

The author then proceeds to point out the importance of a high average load, as reducing the stand-by losses. Electrically-driven auxiliaries are commended. It is mentioned

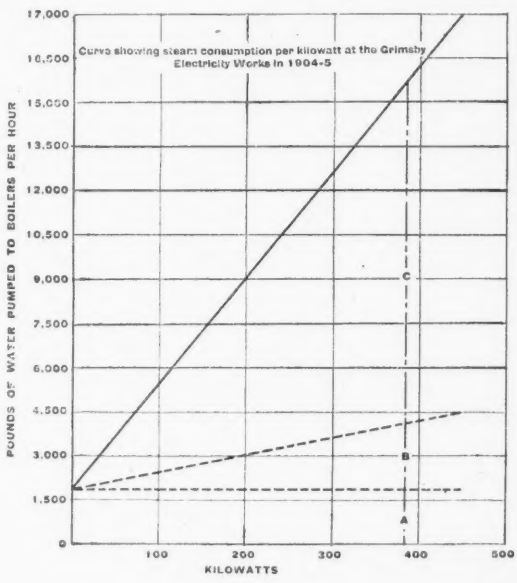


FIG. 1.

that there does not appear to be much difference between the economy of steam and electrically-driven sets on the test plate. For example, "a compound steam engine was installed at the Grimsby Works a year or two ago, driving the air and circulating pumps; this took 808 lb. of steam per hour on test for the following duty:—Pumping 68,000 gallons of water per hour against a head of 26 ft., and maintaining a vacuum of 26 in. of mercury while passing 7,000 lb. of water per hour through the condenser. A contract has recently been let for an electrically-driven plant of the same capacity, but to pump against a head of 35 ft., and the makers have guaranteed a maximum consumption of 27 units per hour under penalty. This at 35 lb. of steam per KW.-hour would represent about 940 lb. per hour. If, however, there is no saving shown on the test plate, the author thinks a very large saving would be shown in practice owing to the reduction in length of the steam pipes and the number of the valves, drains, &c." Manifestly, the electrically-

driven plant does offer a material advantage on the test plate when the extra 9 ft. head is allowed for.

In dealing with the size of engines, the author advocates the use of large units. Considering the number of small sets, he is blessed (?) with at Grimsby (where, owing to the configuration of the town, two separate bus-bars are run at different voltages), it is not to be wondered at that he suggests three 500-KW. sets as the best for dealing with an estimated maximum load of 1,000 KW. But, setting aside the question of the capital cost of spare plant, "the author's ideal station would be one with everything arranged to run from one large engine, with a second as a stand-by, boilers close to the engine, very short length of steam pipes, small number of bends, drains, &c., and with all auxiliaries electrically driven."

The remainder of the paper discusses what might be done with a 1,000-KW. set with saturated steam at 160 lb. pressure, and electrically-driven auxiliaries. (As the vacuum is not specified, we do not think it necessary to give Mr. Vignoles's figures.)

In conclusion, the author pleads that, "in discussing this paper it must be remembered that all the tests were made on the plant under ordinary working conditions. The tests quoted are not given as being good examples of efficient working, as it is recognised that they show many points where economies should, and the author hopes will, be made, but the paper is put forward as an attempt to show what goes on in a central station with a plant five years old."

A Harrogate Convert.

A paper on "Live Steam Heated Feed Water" by Mr. Geo. Wilkinson, of Harrogate, is evidence that the author at least has become a convert to the systems of feed heating and combustion that for so many years we have steadily and persistently advocated in these columns. The point which the author endeavours to make is that boilers fed with cold water will evaporate less than if fed with fully heated feed water, in a degree out of all proportion to the difference of the heat represented by the water temperatures. Had Mr. Wilkinson thoroughly read the paper by Booth and Kershaw from which he quotes, he would have found that the authors of that paper do not make the statement with which he allows them to be debited by a critic of the paper, and that they insist on the boiler being an evaporator only.

We cannot agree that a Lancashire boiler, 30 ft. × 8 ft. 6 in., is considered to be doing good work when evaporating 7,000 lb. per hour. With fully heated feed such a boiler will do very much more than this, and the author can see this done in Lancashire. On the whole, however, Mr. Wilkinson's paper is a piece of special pleading for better steam practice and better furnaces in electrical stations, and we have heard of a large London power station to which it was proposed to apply a system of fully heated feed that would, with superheat, have reduced the number of boilers by one-third. Normand showed years ago that a boiler could be made to give more work and better efficiency when the feed water was heated by the steam from the boiler itself, and the best practice favours the final passing of the feed water, no matter how hot, through a vessel in which it will descend through steam at full boiler pressure—and temperature—before it enters the boiler, thus entirely removing from the boiler all feed-heating duty, which the author now condemns, and very properly, even if a trifle late in the field. We are glad to find him scouting the idea that it is good practice to consider as feed heaters certain tubes in a water-tube boiler. Why do this and take the attendant risks of non-efficiency when a live steam final heater is available? It is certainly a mistake to suppose that in a water-tube boiler the duty of an economiser can be satisfactorily performed.

Comparing water-tube with Lancashire boilers, the author finds that the evaporation of the water-tube boiler per square foot of surface is very low. Where it was trebled by thermal storage, the actual evaporation rate was only 6·34 lb. per sq. ft. after all, and the normal rate of the author's Lancashire boilers is 5·28 lb. Here, of course, the author has made the discovery of the weak point of the water-tube boiler and of the thermal storage system, because the stored water may be all exhausted. He quotes Mr. Hamilton, of Belfast, who shows that economisers save from 4 to 6 per cent. more than they apparently account for by the difference of water temperature. This, of course, may be a specific heat effect, for the specific heat of water, normally unity, no doubt increases with temperature, and is therefore not to be accounted for as mere temperature heat. In brief, there seems to be no doubt that metal plates will carry much more heat to water which can only absorb heat and render it latent than they can to water that has a temperature less than that of ebullition.

We note that the author is following our oft-repeated advice as to furnaces, and is trying to do so by lining the furnaces of his Lancashire boilers with firebrick. It is the correct thing to do if—and it is a large *if*—he can get bricks to stand. We are aware they do stand fairly well in the complete cylinder of a grateless dust-fired boiler, but we have heard of trouble with the half circle of the furnace above the grate, and the bricks reduce the grate surface, but they ought to help the rate of combustion. The author gives diagrams purporting to show for the Bow electric station of the Charing Cross and City Co., and for the Fisk Street works in Chicago, how much space could be saved by employing Lancashire as compared with water-tube boilers. He proposes the Lancashire boilers to be 40 ft. × 11 ft., which is very fine, and, no doubt, good practice, but how about carrying them? The 12-ft. boilers at Saltaire Mills had to be carried by road, for no railway would take such boilers.

The author completes his paper by reference to the waste of fuel in boiler furnaces, due to burning more fuel than the boiler can utilise at that temperature, the inference being that by a higher furnace temperature alone can more duty be secured, and this, probably, he hopes to show with his lined furnaces.

As usual, when two papers are given together, the first one claimed most of the attention of the critics, who were not few in number, and devoted their attacks to such errors as they had discovered in the paper rather than to the principles enunciated, principles which, if carried out, would certainly effect much good. Among the speakers were Messrs. Shawfield, Crossland, Brydges, Sinclair, Stromeyer, Boot, Booth, Snell, Newington and others, but the discussion was desultory and not of a searching order, while some of the speakers who may have uttered pearls of wisdom dropped them so gently that they were inaudible. The few who dealt with principles supported Mr. Wilkinson in his advocacy of stage heating of the working fluid, and the reservation of the boiler for evaporative duty only. We understood Mr. Stromeyer to advocate the rapid flow of gases over the heating surfaces, as well as of water over the opposite sides of the plates. Mr. Boot wants counter flow of hot gases as much as possible. Some believed that feed heating did give better effects than the mere heat addition to the feed would appear to justify; others denied this. Still, the fact remains, that the paper has been put forward by a municipal electrical engineer, so that there is hope of further converts to the sound principles inculcated.

Visits.

Four power houses in all were visited by the members, namely, Lot's Road, of the District Railway; Chiswick, of the L.U.T. Co.; Bow, of the Charing Cross and City Co.; and the Meridian station of the L.C.C.

At the first, the points which appealed to the visitors were the enormous size of the station and the small amount of running plant, together with the noise of the machinery and the severe tremor and the shaking of the hand rails. This visit was of a very hurried nature, for a second station was on the list for this same Wednesday afternoon—that of Sir J. Clifton Robinson, with its grand air of "Si monumentum requiris, circumspice." At any rate, this station is free from that monumental ugliness which characterises the others visited. The water-cooling towers at Bow attracted notice, as also did the engines, which served as a good argument for the reciprocating party.

The comparatively easy march of the engines at Greenwich, which was visited on Friday, was not such as to suggest any trouble with vibration. However, the fact seems to be admitted, and it only remains to move the station or—but we must not further comment on matters still *sub judice!* As a set-off to an arduous week, in addition to the National Physical Laboratory, which was open to members from 11.0 to 1.0 on Saturday, there was given to each member the honorary membership for the day of the Albany

Club, and from the pleasant shaded lawn of that hospitable club were witnessed the Lifeboat Saturday Fund Carnival and Water Sports of Kingston, Surbiton and District. The band of the East Surrey Regiment added to the pleasure of the day.

One of the attractions of the Regatta was apparently devised as an allegorical representation of a recent Westminster play of Ancients *versus* Moderns, the ancients being represented by a body of prehistoric men headed by a ferocious fellow with a shock of flaming hair, who, with his fellow riders in canoes and coracles, and his freemen and others, endeavoured to oppose the ball of progress, which was urged between the goal posts by modern men in silk hats. All the posts seemed to be in possession of the prehistorics, who, clad in skin hearthrugs, were much less punctilious in their use of the weapons of offence with which they were armed than were the Moderns. When all was over, the prehistorics settled themselves in a concrete mass up a cedar pole, and ultimately were observed to sneak into modern garb and endeavour to divest themselves of the appearance of antediluvianism in which they had endeavoured to stem the advance of the sphere to its ultimate goal.

The Annual Dinner.

On Thursday evening the annual dinner of the members was held at the Wharncliffe Rooms, Hotel Great Central, the chair being taken by Mr. J. E. Edgcome. Supporting the chairman were Sir Alexander Kennedy, Mr. C. D. Taite (vice-president), Colonel Crompton, and Dr. Glazebrook, the total number of guests being about 150.

After dinner, the usual loyal toast was submitted by the chairman, and Mr. S. E. Fedden (Sheffield) proposed that of "London and other Local Authorities," to which response was made by Alderman Bruce (Sunderland) and Alderman Bussey (chairman of the Electricity Committee of Poplar Corporation).

Sir Alexander Kennedy, in proposing "The Incorporated Municipal Electrical Association," referred to the great strides which municipal trading had made in recent years, and said that he thought the municipal engineer had done no small part in making the wheels of municipal trading go round as smoothly as possible. He also gave the members very valuable advice on the present tendency to outvie one another in the matter of works costs regardless of magnitude of operation, conditions of supply, or local surroundings.

The toast was coupled with the name of the President, and Mr. Edgcome, in responding, said that Sir Alexander Kennedy had dealt fully with municipal trading, and he would not therefore attempt to deal with the subject, although there were several matters he would have liked to touch upon. As engineers they were, he said, very much alive to the importance of keeping a correct balance at the top, and of cutting down their prices to the lowest figure in order to attain this object. But it was not always easy to persuade committees that their figures were correct.

Mr. C. D. Taite (Salford) proposed "Our Guests," and Col. Crompton, R.E., and Dr. Glazebrook responded. During the evening a musical programme, contributed to by Miss Margaret Cooper and Messrs. James Godden and Walter Hyde, was carried out.

The speeches were somewhat one-sided, and pointed strongly to the need for broadening the base on which the Association is constructed. Every association of officials of public bodies inevitably tends to an after-dinner speech-making, which resolves itself into a glorification of municipal authority in mundane affairs. Even the present unenviable notoriety of Poplar did not stale the infinite variety of charm which Alderman Bussey, of Poplar, found to be an integral part of the official doings at that place, and the worst feature of the whole was that there appeared a disposition to make light of corruption. Private companies and enterprise were declared thoroughly bad by one speaker, and generally the speeches gave strong support to that growing disposition to cut out all formal talking from gatherings of this nature. We should strongly recommend the admission of all station engineers into the Association. As it is, if a man ceases to be a municipal official he has to resign from the Association, and leave his friends. It seems ridiculous.

The annual general meeting was held on Thursday, 21st inst., when Sheffield was chosen for the meeting place in 1907 with Mr. S. E. Fedden as president. Mr. J. E. Edgcome was elected treasurer in succession to Mr. J. H. Rider. Mr. H. Talbot was elected to a place among the vice-presidents. The new members on the Council will be Mr. Alderman Dowson, Mr. J. F. C. Snell (a past president) and Mr. W. Bates. The report and balance sheet for 1905 were adopted, and a resolution amending the Articles of Association was passed.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

10,802A. "Improvements in and relating to the electrolytic deposition of metals." S. O. Cowper-Coles. June 12th. (Date applied for under Rule 5 of the Patents Rules, 1905, May 8th, 1906.)

17,699A/05. "Improvements in or relating to controllers for electric circuits." M. B. Field and Ferranti, Ltd. (Date applied for under Rule 5 of the Patents Rules, 1905, September 1st, 1905.) June 16th.

13,368. "Improvements in or connected with starting switches for electric motors." J. B. McIndoe. June 11th.

13,370. "Improvements in the electric transmission of power on road vehicles and in apparatus therefor." R. Kennedy. June 11th.

13,373. "Improved method for the prevention of sparking in current interrupters and the like." F. Schneider. June 11th. (Complete.)

13,381. "Improvements in and relating to electric light brackets." E. F. Hug. June 11th. (Complete.)

13,391. "Improved electric cooking stove." D. C. Smith. June 11th. (Complete.)

13,402. "Improvements in electrical feeder and distribution cable disconnecting boxes and feeder pillar panels." L. de Rathier du Verge. June 11th.

13,413. "Improvements in and relating to vapour electric apparatus." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) June 11th.

13,415. "Improvements in electric switches and operating mechanism therefor." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) June 11th.

13,427. "Improvements in variable speed electric motors." J. C. Lincoln. (Date applied for under Patents Act, 1901, June 27th, 1905, being date of application in United States.) June 11th. (Complete.)

13,442. "Improvements in electric batteries." W. Moseley. June 12th.

13,450. "Improvements relating to trolley poles of electric tramcars and the like." J. H. Collie. June 12th.

13,460. "A simplified method of obtaining perfect synchronisation in the ignition of motor-cycle and tricar engines having two cylinders." R. E. Faithfull-Davies. June 12th.

13,491. "Telephone receiver." H. T. von Nathusius. June 12th. (Complete.)

13,502. "Improvements in and relating to alternating current dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) June 12th.

13,508. "Improvements in alternating current motors." Siemens Bros. and Co., Ltd., and M. Kloss. June 12th. (Complete.)

13,517. "Improvements in electro-magnetically controlled switches and circuit breakers." P. S. Brook and J. A. Hirst. June 13th.

13,542. "Improved automatic electrical clock." J. G. Knight. June 13th.

13,543. "A non-magnetic compass." C. Bulmer. June 13th.

13,552. "Improvements in or relating to electric arc lamps." A. Cotis. June 13th. (Complete.)

13,567. "Improved apparatus for controlling electric motors." Siemens Bros. and Co., Ltd., and F. Turner. June 13th. (Complete.)

13,568. "Improvements in electrical apparatus for firing mines or blasting charges." K. Schaffler and D. Weiss. June 13th.

13,585. "Apparatus for enabling the transformation of a single-phase alternating current into a continuous current." L. R. Auvert and A. F. E. Ferrand. (Date applied for under Patents Act, 1901, July 3rd, 1905, being date of application in France.) June 13th. (Complete.)

13,589. "Improvements in electrolytic meters for electricity." E. M. y Miura. June 13th.

13,594. "Improved signalling or telegraph apparatus." R. B. North. June 13th.

13,596. "Improvements in and relating to incandescent electric lamps." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) June 13th.

13,597. "Improvements in electric heaters especially for use in vulcanising vehicle tires." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) June 13th.

13,600. "Improvements in and relating to electric circuit interrupting devices." E. Schattner. June 13th.

13,601. "Improvements in electric switches." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) June 13th.

13,602. "Improvements in or relating to electric switches." A. White. June 13th.

13,603. "Improvements in or relating to brush-holders for dynamo-electric generators and motors." A. White. June 13th.

13,651. "Improvements in electrical contact makers and breakers and the like particularly applicable for use with internal combustion engines." C. A. Hamilton. June 14th.

13,654. "Improvements in or relating to the reproduction of letters or devices by means of electricity." S. Wynberg and K. de Vries. June 14th.

13,670. "Electrically operated safety valve." A. W. Jenczewsky. June 14th. (Complete.)

13,673. "Improvements in apparatus for starting and regulating electric motors." G. C. Fricker. June 14th.

13,690. "Improvements in reactive coils especially applicable to systems of electric distribut on employing vapour rectifiers and the like." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) June 14th.

13,691. "Improvements in electric motor control systems and apparatus." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) June 14th.

13,693. "Improvements in insulated conductors." F. Kuhlo. (Date applied for under Patents Act, 1901, June 17th, 1905, being date of application in Germany.) June 14th. (Complete.)

13,697. "Improvements in and relating to electric traction systems." Allgemeine Elektrizitats Ges. (Date applied for under Patents Act, 1901, June 14th, 1905, being date of application in Germany.) June 14th. (Complete.)

13,699. "Improved process for the electro-deposition of iron." S. O. Cowper-Coles. June 14th.

13,731. "Improvements in electric accumulator plates." H. Terry. June 15th.

13,750. "Improvements in the insulation, protection and manufacture of electric conductors." G. R. Neilson. June 15th.

13,760. "Improvements in or relating to electrical contact-breakers for internal combustion engines." C. A. Hamilton. June 15th.

13,782. "Improvements in and connected with electric motor-generators." H. Leitner. June 15th.

13,795. "Improvements in or relating to apparatus for the electrical production of heat for cooking and other purposes." A. F. Berry. June 15th.

13,818. "Improvements in electric switches." G. M. Newberry and the British Prometheus Co., Ltd. June 16th.

13,822. "Improvements in condensers for electrical purposes." J. A. Romer. June 16th.

13,836. "Improved arc lamp." L. Ocenasek. June 16th. (Complete.)

13,841. "Improved electric heater or burner for singeing threads and textile fabrics." C. F. Kaisser. June 16th. (Complete.)

13,844. "Improvements in induction motor control." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) June 16th.

13,845. "Improvements in and relating to magnetic separation." Newton Bros. & R. Newton. June 16th.

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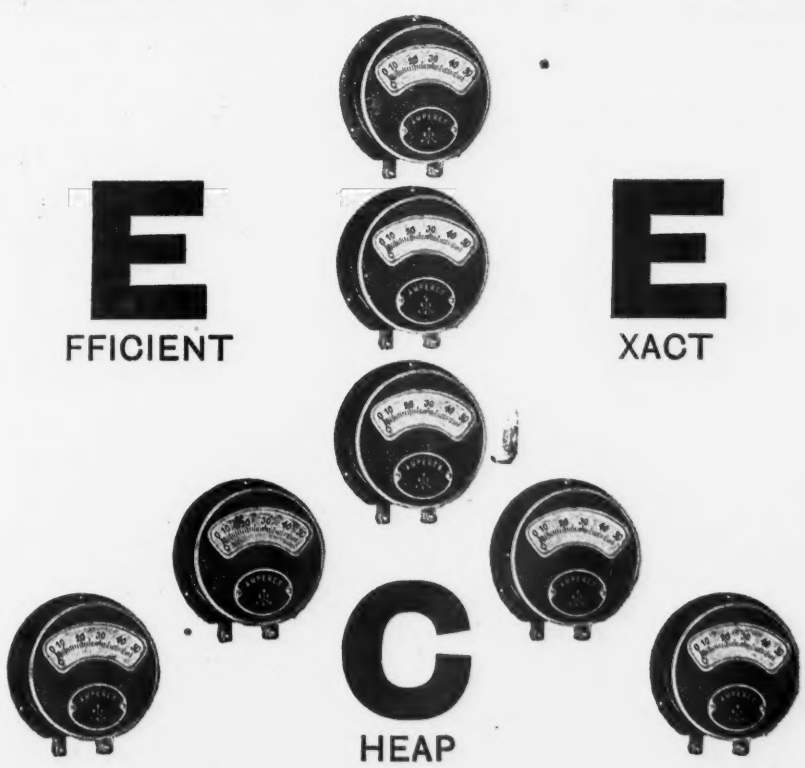

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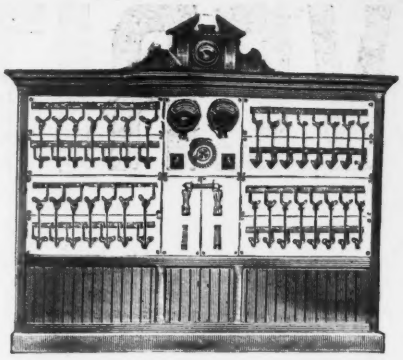

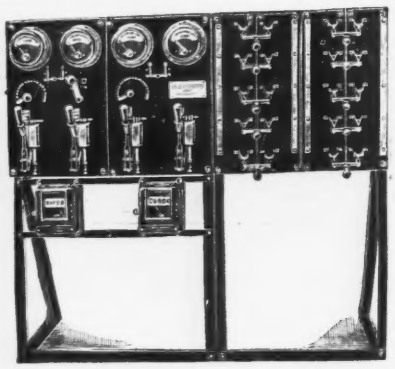

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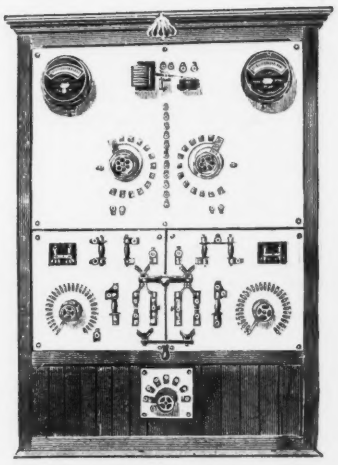

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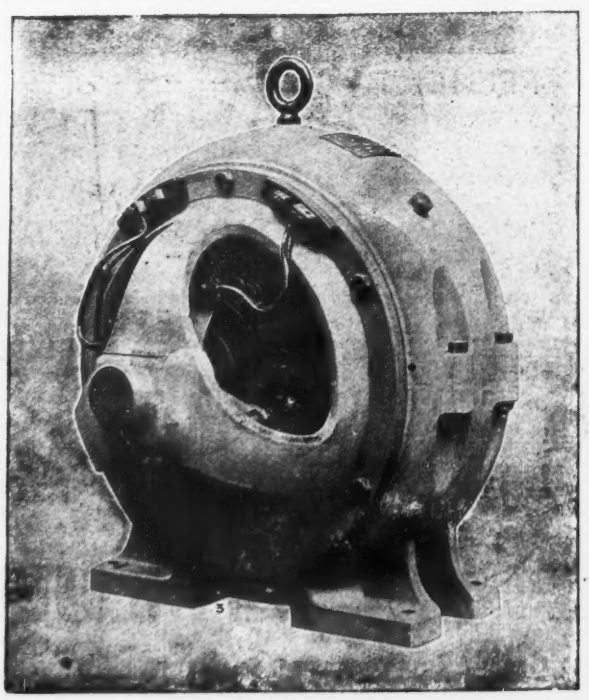

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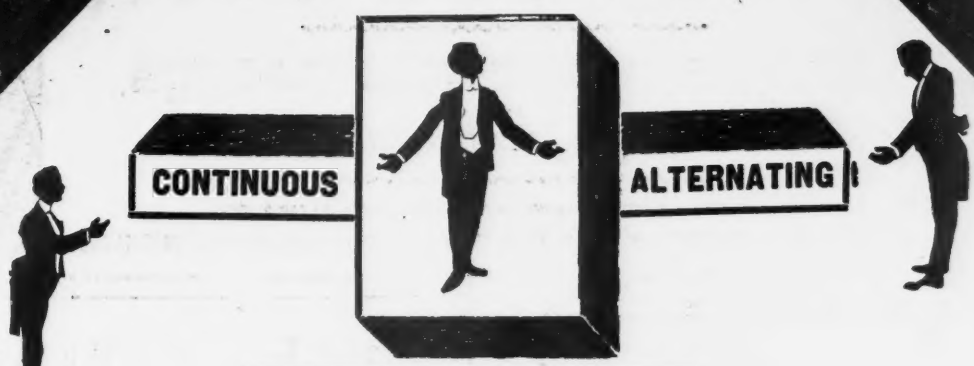

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CARBON BRUSHES

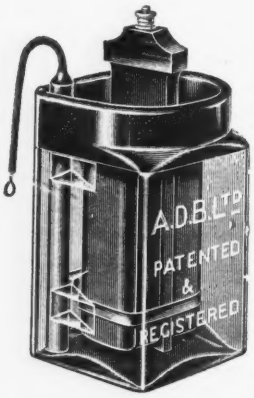
FOR

DYNAMOS AND MOTORS.

PRICE LIST AND ALL INFORMATION ON OUR DIFFERENT QUALITIES ON APPLICATION.

17, WATER LANE, GREAT TOWER ST., E.C., LONDON.

"BEST BRITISH BATTERIES."



Send us your enquiries, it will pay you.

Manufactured by

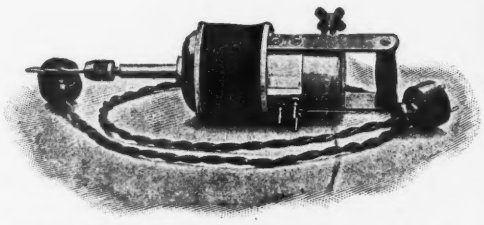
THE AMALGAMATED DRY BATTERIES, Ltd.,

16 and 17, Devonshire Square, Bishopsgate St., London, E.C.

Telephone: 8876, London Wall. *Works:* London, E.C. *Telegrams:* "Footbridge, London."

The "FEATHERWEIGHT"

ELECTRIC HAND DRILL.



Weighs only 10 lbs. and drills up to ¼ in.

Geared Hand Drilling Machines for One or Three Speeds, Portable Drills with Flexible Shaft, Electric Grinding and Polishing Machines a Speciality.

S. WOLF & CO.,

138, SOUTHWARK STREET, LONDON, S.E.

Telephone: 5172 Central. Telegrams: "Widerstand London."

BEFORE PURCHASING ELSEWHERE ask for the

'BRIMSDOWN' BRAND

OF

Genuine Ground Litharge.

SPECIALLY MANUFACTURED FOR

BATTERIES, ACCUMULATORS, and other Electrical Purposes.

The Name *"BRIMSDOWN"* IS A GUARANTEE OF SUPERIORITY.

FOR SAMPLES AND PRICES ADDRESS THE SOLE MANUFACTURERS.

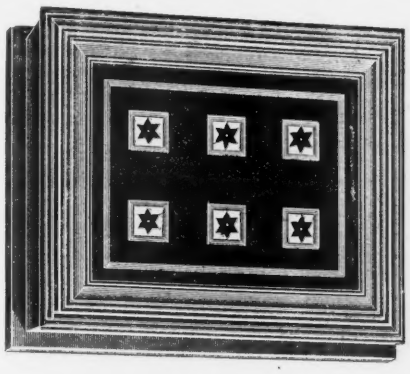
BRIMSDOWN LEAD COMPANY, LIMITED,

Telegrams: "Hydration, London." 37 and 38, MARK LANE, LONDON, E.C. Telephone 1124 Avenue.

'STERLING' ELECTRIC BELL SUPPLIES.

A FEW OF OUR STOCK PATTERNS.

No. U 3535.
Brass Indoor Push.



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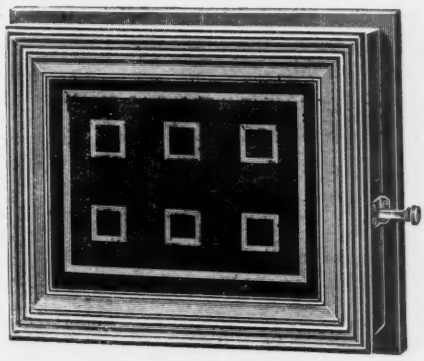
Ordinary Quality Pendulum Indicator.

BATTERIES

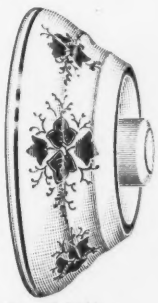
INSULATORS

No. U 3200.
Ornamental Hanging Push.



No. U 3105.
Ordinary Quality Mechanical Replacement Indicator.

TELEPHONES.



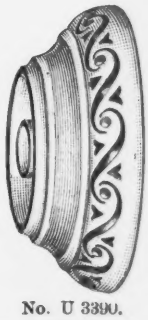
No. U 3360.
Decorated China Push.

No. U 3210.
Ornamental Hanging Push.

No. U 3040.—3" Underdome Bell on Wood Base.

EXPLODERS.

No. U 3205.
Carved Pear Push.



No. U 3390.
Decorated China Push.

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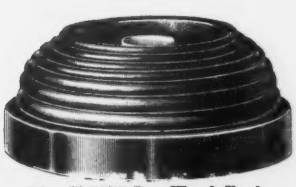
No. U. 3030. Tyrolese Bell.

BUZZERS

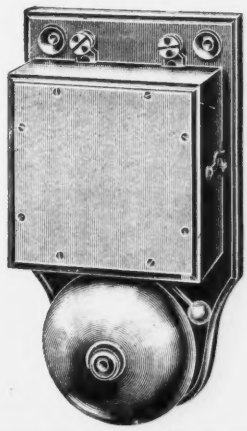
RELAYS, &C.

No. U 3190.—Pear Push.



No. U 3175 B.—Wood Push.

THIEF ALARMS.



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PRICES OF ABOVE SEE 6th EDITION CATALOGUE.

THE STERLING TELEPHONE & ELECTRIC COMPANY,

LATE THE BERLINER TELEPHONE MFG. CO.,

200, Upper Thames Street, LONDON, E.C.

TO COOK BY ELECTRICITY

"IS NOW QUITE THE THING."

The many advantages which electricity possesses over other methods of heating are too pronounced to be passed over, consequently now that a satisfactory system has been found sales are going up by "leaps and bounds."

Now is the right time to push this line; don't wait until the hot weather has gone by. Write to-day for particulars of the

G.E.C. SYSTEM.

Bear in mind G.E.C. ELECTRICAL COOKING APPARATUS is not a new idea of mushroom growth, but is the outcome of many years' careful study and research, and can be recommended with ABSOLUTE CONFIDENCE.

We have large stocks of

ELECTRIC OVENS.	ELECTRIC KETTLES.	ELECTRIC COOKERS.
ELECTRIC HOT PLATES.	ELECTRIC SAUCEPANS.	ELECTRIC HOT WATER JUGS.
ELECTRIC PLATE WARMERS.	ELECTRIC WATER HEATERS.	ELECTRIC IRONS.
ELECTRIC URNS.	ELECTRIC FRYING PANS.	ELECTRIC SHAVING POTS.
ELECTRIC FISH KETTLES.	ELECTRIC GRILLS.	ELECTRIC CIGAR LIGHTERS.
	&c. &c. &c.	

SEND US A SAMPLE ORDER AND ASK FOR BOOKLETS.

REGD TRADE MARK

THE GENERAL ELECTRIC CO., Ltd.

HEAD OFFICE: 71, QUEEN VICTORIA STREET, E.C.

Works and Branches: Manchester, Birmingham, Witton, Glasgow, Hammersmith, Southwark, Newcastle, Dublin, Cardiff, Belfast, Paris, Capetown, Johannesburg.

THE ELECTRICAL REVIEW CHEAP PREPAID ADVERTISEMENTS.

(LATEST TIME for receiving 12 noon Thursdays.)

Relating to Situations Vacant, Situations Wanted, Businesses Wanted, Businesses for Sale, Patents for Sale, Specific Articles of any kind Wanted, or for Sale or Exchange, are inserted at the rate of ONE PENNY Per Word (minimum 1s.)
Box Number and "Electrical Review" Address count as Seven Words.

Where Advertisements are to be answered to a given number at the ELECTRICAL REVIEW Office,
applications for Names and Addresses of the Advertisers will be entirely disregarded, and Letters giving Incorrect Box Numbers will be destroyed.

THREE CONSECUTIVE INSERTIONS FOR THE PRICE OF TWO.

**** The Scale does not apply to Trade Advertisements, terms for which can be had on application to 4, Ludgate Hill, London, E.C.

DISPLAYED ADVERTISEMENTS. { ***Advertisers will please note that New Copy and Alterations to Existing Advertisements (with Blocks) should reach here not later than MONDAY Morning.***

The "Electrical Review" is the recognised medium of the Electrical Trades, and has BY FAR THE LARGEST CIRCULATION of any Electrical Industrial Paper in Great Britain.

WHEATLEY KIRK, PRICE & CO.

(Established 1850),

VALUERS,
ARBITRATORS &
AUCTIONEERS.

Every Section of the Electrical Trades,
Tramway Undertakings,
Electricity Supply Works.

LONDON: 46, Watling Street, E.C.
Telephone: 5077 Bank; Telegrams: "Indices, London."

MANCHESTER: Albert Chambers, Albert Square.
Telephone: 3218 Central; Telegrams: "Indicator, Manchester."

SITUATIONS VACANT.

Latest time for receiving, 12 noon Thursday.

If letters are not to be delivered to certain firms or individuals (if known), instructions to that effect should be sent to the Manager of the ELECTRICAL REVIEW, who will do his best to carry out such instructions. Letters of applicants cannot in such cases be returned to them, nor can the names of Advertisers using a number in any way be disclosed.

Original Testimonials should never be sent.

METROPOLITAN BOROUGH OF WOOLWICH.

ELECTRICITY DEPARTMENT.

Appointment of Commercial Assistant.

THE COUNCIL of the above Borough invite Applications for the Appointment of Commercial Assistant in their Electricity Department.

Applicants must have received a good commercial training, and have a technical knowledge of, and be fully conversant with, the various applications of electricity for lighting, power, and heating purposes.

The person appointed will be responsible to the Electrical Engineer for all matters pertaining at the sale of electricity, and the extension of the business of the department.

The salary will commence at £200, and be substantially increased as the undertaking develops.

Applications to be accompanied by copies only of not more than three testimonials, must be on forms, which together with particulars of the appointment, can be obtained on application to the Acting Borough Electrical Engineer, Town Hall, Woolwich, and must be sent, addressed to me, not later than 12 noon, on Monday, July 9, 1906, endorsed "Commercial Assistant."

Canvassing members of the Council, either directly or indirectly, will disqualify.

By order,
ARTHUR B. BRYCESON,
Town Clerk.

Town Hall, Woolwich,
June 25th, 1906. 8729

BRIGHTON CORPORATION.

WANTED immediately, neat, quick Draughtsman, used to general engineering and electrical work, keeping up mains, maps, and records. Commencing salary 40s. per week.

Reply, stating age, experience, when free, and enclose references to

JOHN CHRISTIE,
Engineer and Manager,
Corporation Electricity Works,
Brighton. 8728

SITUATIONS VACANT.—*Continued.*

BEXLEY URBAN DISTRICT COUNCIL.

GENERAL ASSISTANT wanted at once on tramways staff. Not under 27. Must have workshop training, be a fair draughtsman and some experience of permanent way repairs would be an advantage.

Salary 35s. to 45s. per week according to experience. Further particulars of the tramway manager, to whom applications and copies of references should be sent not later than July 7th, 1906.

THOS. G. BAYNES,
Clerk.

Car-Sheds, Bexley Heath,
Kent. 8625

ASSISTANT MANAGER.

AN OLD-ESTABLISHED FIRM in the West End of London, dealing in Works of Art and High-class Fittings for Lighting and similar purposes, requires the services of an Assistant Manager.

The Applicant should preferably be between 30 and 40 years of age, must have taste and knowledge of styles and be able to produce Sketches, Designs and the necessary Working Drawings to meet the suggestions of Customers.

He must be well acquainted with the present requirements of Electric Light Installations and with modern practice in Wiring Work, and should be able to prepare Tenders for and superintend the carrying out of Contracts.

The salary offered is £250 to £300 a year to commence with, according to experience, and a liberal commission on the profits of the Business.

The Person selected will be required to devote his whole time to the Business.

Applications, which will be treated as confidential if desired, giving particulars of training and experience, with copies of testimonials or references, should be sent in the first instance to 8725, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SOUTH OF ENGLAND.

THE following are required for a large Central Station in the South of England; only men who possess experience in similar capacities will be considered:—

System:—Three-wire continuous current with batteries, Babcock boilers, high-speed engines, lead-covered paper cables.
Three Shift Engineers with thoroughly good steam experience, 56/-, 60/-, and 64/- respectively for 56-hour week.
Three Switchboard Attendants, 35/- for 56-hour week.
One Supervisor of Mains, to be capable of undertaking location of faults and testing, 50/- per week.

Applications, giving full particulars, to be addressed to Box 629, c/o Messrs. R. F. WHITE & SON, General Advertising Agents, 33, Fleet Street, E.C. 8719

Owing to the many hundreds of replies passing through this Office each week, we would ask those answering Advertisements to be extremely accurate in giving the correct figures when addressing replies to Box Numbers.

Where Advertisements are to be answered to a given number at the ELECTRICAL REVIEW Office, applications for names and addresses of the Advertisers will be entirely disregarded.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two.
Box Number and ELECTRICAL REVIEW address count as seven words.

A BOROUGH Electrical Engineer has a vacancy for a premium pupil, steam and gas plant, wiring and installation work; also theoretical tuition given.—8702, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(Continued on next page.)

SITUATIONS VACANT.—*Continued.*

A.—A Number of Appointments at commencing salaries of £100 to £150 per annum are open at the present time in the Submarine Cable and Wireless Telegraph Companies to smart young men. Small Premium only. Short course of tuition.—Apply for particulars and Prospectus to the SECRETARY (c), The London Telegraph Training College, Morse House, Earl's Court, S.W., which is the only Training Institution of its kind in the United Kingdom which can show a record of hundreds of Past Successes, and which is staffed entirely by Instructors who have had practical experience in the subjects taught. The College is Licensed by H.M. Government for Wireless Telegraphy, and is equipped with the latest types of Apparatus. 7525

A COMPETENT Electrician wanted to conduct business; must be practical in all branches, including telephones; able to superintend men. Wages to begin, 50s. weekly.—Apply 8674, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A LARGE firm of Electrical Contractors have an opening for Assistant Engineer. Must be used to management of men. State salary required and previous experience.—8716, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A LIMITED Company require the services of a Competent Engineer with experience of modern Electrical Practice who is willing to undertake duties in South Africa, one prepared to interest himself financially preferred.—8552, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A YOUNG Man, of good appearance and address, wanted to represent a first class company. Good remuneration and prospects of early promotion to a capable man with good references.—8705, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

APPRENTICE.—Vacancy for Apprentice or Pupil in D.C. Generating Station.—ENGINEER AND MANAGER, Leatherhead and District Electricity Supply Co., Ltd. 8743

ARC Lamp Tester wanted; preference to one accustomed to expeditious testing of Miniature Arc Lamps.—Apply, letters only, FOSTER & Co., Arc Lamp Manufacturers, Wimbledon, S.W. 8696

ARMATURE Winders wanted in East London district; knowledge of alternating current machines necessary. State experience and wages expected.—8664, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARMATURE winders wanted by firm in Manchester district. State experience and wages expected.—Address, 8601, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN required with long experience in electrical engineering, used to dealing with large units, both continuous and alternating.—Apply, stating age, qualifications, salary, &c., 8658, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN wanted at once. Smart Junior, with experience in making working drawings of electrical instruments.—8721, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN, thoroughly experienced, well up in the design of small continuous current machinery.—State age, experience and salary required to 8699, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN wanted, well up in cable joint box design. Knowledge of constructional ironwork a recommendation.—Write, stating salary, qualifications, and age, 8681, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ENERGETIC Shop Manager required for Electrical Apparatus and Switch Manufacture. Only best men need apply.—8476, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ENERGETIC Young Man with connection amongst contractors wanted, as Manager for Wholesale Trade House in Yorkshire, with good connection. Will have part travelling. No capital required. Remuneration, half profits.—8520, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ESTIMATING Clerk for Contractor's Office, must be able to measure and price accurately from plans and buildings for all classes of lighting and power work. Some knowledge of drawing necessary.—Apply, stating age, experience, and salary required, 8678, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FIRM of Contractors require services of capable Electrician with first-class experience of lighting and power work. Must be able to interview, estimate and supervise.—Apply, stating full qualifications, experience and salary required.—6847, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

GOOD Designing Draughtsman wanted for the Switchgear Department of large Electrical Engineering Firm.—State age, experience, and salary expected, 8684, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

JUNIOR Draughtsman required by a leading arc lamp firm. Must be used to seeing small work through shops.—Apply, stating salary and when disengaged, in confidence, to 8690, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

KYNOCH Limited require the services of an Electrical Engineer, unmarried and not over 30, for work in South America. Must have had commercial and thorough technical experience. Man already acquainted with South America preferred.—Apply by letter only, with full particulars of past experience, age and salary required to SECRETARY, Kynoch Limited, Lion Works, Witton, near Birmingham. 8709

SITUATIONS VACANT.—*Continued.*

PREMIUM Pupil.—Vacancy in municipal combined lighting and traction department in Midlands.—Reply 8724, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PROMINENT Electrical Manufacturing Firm are desirous of securing the services of a qualified Power Engineer as Assistant to Branch Office. The gentleman appointed must have an excellent technical and commercial experience, relating particularly to the colliery and textile industries, and preferably an old P.S.B. A commencing remuneration of £200 p.a., with second-class expenses would be granted to gentleman substantiating a sound connection.—Send full particulars in confidence, addressing in the first instance 8660, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SMART Traveller wanted per August, for selling Electric Light Speciality to large consumers. Good connection with large Stores, Factories, Municipalities, and Government Departments essential. Salary and commission.—Apply, stating full particulars to 8662, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SWITCHBOARD Attendant wanted immediately to assist on evening shift. Wages 20s. per week. Applications, stating age, experience, and enclosing copies of not more than three testimonials, to be sent not later than 7th July to ENGINEER, Electricity Works, Canterbury. 8686

TELEGRAPH Appointments.—Young Men trained for excellent positions in the Submarine Cable and Wireless Telegraph Services, at the BRITISH SCHOOL OF TELEGRAPHY, 179, Clapham Road, London, S.W.; Principal, Mr. William Lynd, the well-known Science Lecturer and Telegraph Expert. Fees moderate. Easy method of payment if desired. Highest references. Tuition thorough, including nomination. Individual attention. Good salaries. IMPORTANT NOTICE.—The Principal has the authority to use for the training of Wireless Telegraph Operators, Marconi Installations supplied by Marconi's Wireless Telegraph Co., Ltd.—Write at once to SECRETARY for full particulars. 8239

TEST-ROOM Assistant wanted for South Coast Station. Commence 25s. per week.—State age and previous experience to 8677, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TO demonstrate the utility of a course in Engineering (or Practical) Mathematics, the Correspondence School of Engineering Mathematics, Bilston, Staffs., will forward to anyone who will return same within five days, a copy of Prof. J. Perry's "Lectures" on this subject. 8589

TRAVELLER.—Leading firm of Electrical Accessories and Switchboard Makers requires the services of a Gentleman to represent them in the Midlands. Applicants must have good connection with contractors and consulting engineers.—State experience, terms, and when disengaged.—8481, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED at once, an Apprentice in generating station, small premium.—Apply, L. H. KING, Electricity Works, Whitby. 8406

WANTED a Draughtsman, used to Electric Motors and Lifts.—Apply, giving full particulars of salary, experience, &c., to 8415, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, by Electrical Manufacturers of high repute, an energetic Assistant Representative for Lancashire and Yorkshire District. A sound connection is essential, and the gentleman appointed must be capable of testing motors, arc lamps, &c., and an old P.S.B. preferred. Commencing remuneration £130—150 p.a., with second-class expenses.—Send full particulars in confidence, addressing in the first instance, 8659, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Working Foreman for Electric Brass Turning and Finishing Workshops. Must be a good Mechanic, absolutely steady and reliable; moderate salary to commence.—Apply by letter to 8663, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Armature Winders for Manchester district; none but experienced men need apply.—State wages expected, 8656, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Foreman for Electrical Switchgear and Accessories Shop. Must be energetic and have held a similar position, accustomed to boys, piece-work and cut prices. Commencing £2 15s. per week, increase if satisfactory; non-society.—8704, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, a Smart Electrical Engineer, with a good knowledge of dynamos and accumulators, and railway experience, to go abroad. Knowledge of Swedish language an advantage. Age about 24.—Apply, stating age, full experience and wages required, to "DYNAMO," c/o Dawson's Advertising Offices, 121, Cannon Street, E.C. 8708

WANTED immediately, Manager, with a view to purchase an Electrical Contracting Business in provincial town in Suffolk. Must have good all-round experience with wiring and general country house installations.—Apply 8687, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED Man to take charge of Country House Plant, consisting of Oil Engine, Dynamo, and Battery; 150 lights; also to drive motor cars and keep them in repair. Only those who have had similar experience need apply.—8742, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(Continued on next page.)

SITUATIONS VACANT.—*Continued.*

WANTED, Junior Shift Engineer in small combined lighting and traction station in Midlands; state salary.—Apply 8741, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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APPOINTMENTS FILLED.

BOX 8371.—The Advertiser thanks all the Applicants for this Post, which has now been filled. 8661

WIREMAN-Canvasser, No. 8343.—Advertiser thanks Applicants for this Post, which is now filled. 8668

SITUATIONS WANTED.

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Latest time for receiving, 12 noon, Thursday.

A.A.—Foreman seeks re-engagement, manufacturing electrical plant and accessories; up-to-date, systematic, good organiser, excellent references, used to full control (age 33).—593, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A.—Electrical and Mechanical Engineer (26), technical graduate, works training; nine years' experience in central stations; traction, home and abroad; desires Appointment with good firm.—8652, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A CAPABLE Electrical Engineer, theoretical and practical training, desires re-engagement. Thorough knowledge all-round. Splendid testimonials.—8651, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A CAPABLE Engineer-Electrician desires engagement, thoroughly conversant with all systems of wiring, able and trustworthy; abstainer. Would take charge of branch.—8666, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A COMPETENT Electrical Engineer desires Position as Branch Manager or Foreman. Experienced in supervision of men, estimating, interviewing, &c.; excellent testimonials.—8707, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A PRACTICAL Man, experienced with large and small Lighting Plants, also Lifts, Pumps, Hot Water and Steam Kitchen, desires appointment as Engineer-in-charge.—Address 8700, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A SMART Respectable Man (age 24), requires engagement as Storekeeper and Overseer; used to presses; had control of 20 lads who made electrical accessories; would accept any responsible position. Town or country.—"P.," 61, London Street, Greenwich. 8675

ADVERTISER, practical electrician (age 29), at present in charge of branch of contracting firm which is handicapped for lack of capital, desires berth with substantial firm.—8544, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER wants charge of switchboard or small plant. Good refs.—"D.," 21, Elsham Road, Leytonstone. 8643

AN Electrical and Mechanical Engineer (25), works training, experience in erecting, testing, power and lighting installations and high-tension alternating station work, desires Responsible Position in works or station; excellent testimonials.—8447, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AN Electrical and Mechanical Engineer (23), desires change, works training and continuous-current station experience.—8576, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AN Improver (19) wants Situation in London. 2½ years' experience in manufacture of arc lamps and small electric apparatus; good references.—8553, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AN Overhead Construction Superintendent seeks Engagement, 12 years' experience in overhead equipment, cables and street lighting, willing to assist with track works.—8556, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARMATURE Winder, experienced Dynamo erection, repairs.—"A.," 180, Lakedale Road, Plumstead, Kent. 8706

SITUATIONS WANTED.—*(Continued).*

CABLE Foreman or Jointer, any cables; plumbing.—BULLER, 35, Upper Albert Road, Sheffield. 8667

CHARGE Hand or Outdoor Foreman seeks change; excellent references.—"L.," 11, West Road, West Ham. 8695

CLERK (21), thoroughly competent book-keeper. Shorthand (100), typewriting (45). Very capable correspondent and good at figures. Moderate salary. Good references.—8566, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

COMMERCIAL Manager.—Gentleman, with 17 years' electrical experience as such, desires Position; highest references; moderate salary.—8614, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

COMPETENT Electrician seeks Situation, charge wiring or private plant.—BULL, 13, St. Helen's Road, Brighton. 8409

COMPETENT Electrician and Estate Engineer, married, one child, seeks charge of private plant, experienced with oil engines, accumulators, motors, pumps, &c., would take over motor car with view to driving.—8685, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DISENGAGED, Experienced Foreman (33), accustomed to profitable manufacture; best work, excellent London references.—8621, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN Designer. First-class experience; H. and L.T. switchgear, detail work, estimating and supervising erection.—8610, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN (22) with practical experience on switchgear.—8407, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

EFFICIENT "Contractors' Right Hand Man." In interviewing, obtaining orders, estimating, designing. Steam, Hot Water, Electric Lift, Pump, Suction Gas, Generating, Telephone, Fire Alarms, &c., installations. Drawing up specifications; 18 years' experience. Nominal salary and commission.—8620, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer.—Englishman trained at Stevens College, Hoboken, America. Drafting and designing a speciality, eight years' experience, requires situation in England. Copies of testimonials and references forwarded on application.—Reply, stating salary offered, to 8585, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Trades Union. Telegrams: "Eltradion, London"; Telephone: 628 Central.—Employers requiring Competent Workmen can obtain same at short notice by use of telephone or post to A. HWEB, Club Union Buildings, Clerkenwell Road, E.C. 5027

ELECTRICAL and Mechanical Engineer, late manager of Electrical Manufacturing Company, thorough theoretical and practical training, desires responsible position.—8488, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer requires situation. Just completed three years' apprenticeship at West End firm. Splendid testimonials.—8469, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (24), desires engagement, preferably in London. All round man; college training. Specialities: H.T. alternating current work, testing. Station and works experience.—8673, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer wants berth; reliable and steady. Oil or steam engines, accumulators, motors, or boosters.—"J. O. P.," 8, Derby Street, Reading. 8676

ELECTRICIAN seeks situation, capable taking charge of plant, good wireman, own repairs.—W. DENNIS, 43, Delafield Road, Charlton, S.E. 8717

ELECTRICIAN, thoroughly competent; lighting, bells, telephones; also good workshop experience.—"ELECTRIC," 31, Darrell Road, Richmond. 8723

ELECTRICIAN (married) wants change, charge of private plant, repairs, &c. Good references.—"ELECTRICIAN," c/o Morris, Outfitter, Bramley, Surrey. 8455

ELECTRICIAN desires charge of Installation; conversant with Alternating, Continuous Current, Armature repairs, Centrifugal Pumps, &c. (Testimonials).—8521, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN (24) seeks Situation, take charge of private Plant, do estate repairs; good references.—Write MARSH, Birlingham, near Pershore, Worcestershire. 8515

ELECTRICIAN, competent, seeks employment; Lighting, Bells, Telephones, town or country.—Milton Villa, Sterne Street, Shepherd's Bush. 8526

ELECTRICIAN, Practical, Wiring or Charge Plant.—FLOOD, 5, Brettenham Road, Walthamstow. 8487

ELECTRICIAN desires situation, good experience, country mansion and factory installations, gas and oil engines, can carry jobs right through; has had complete charge; excellent references.—"C. L.," 27, Como Street, Romford. 8575

ELECTRICIAN.—Youth seeks employment as Mate; two years' experience.—Address, "W. S. R.," 26, Horsell Road, N. 8633

(Continued on next page.)

SITUATIONS WANTED.—*Continued.*

ELECTRICIAN (Foreman) seeks re-engagement, used to the carrying out of large installations, lighting, bells and telephones, first class references.—"W. C.," 36, Dahomey Street, Mitcham Lane, Streatham. 8734

ELECTRICIAN (30), charge or otherwise. Light, bells, telephones, plant. References.—15, Brussels Road, Clapham Junction. 8737

ELECTRICIAN seeks Employment to take charge; good all round.—Address ELECTRICIAN, 13, Child's Place, Earl's Court. 8739

ELECTRICIAN-Wireman, experienced and reliable; rate moderate.—SMITH, 15, Charnock Road, Clapton. 8733

ELECTRICIAN-Wireman (33) several years' references for charge of work; lighting, plant, bench.—"E.," 43, Ivanhoe Road, Peckham. 8727

ENGINEER, A.M.I.E.E. (34), accustomed to manage installation contracting business, estimate, obtain orders, 12 years' experience, college training, seeks position with first-class firm in North of England preferably.—8650, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ENGINEER, with electrical and mechanical training, experienced in the erection and operation of three-phase high-tension and direct-current plant (complete), holding first-class testimonials, seeks change, would take charge.—Address, "G.W.," Cleveland House, Nicholson Road, Addiscombe. 8408

ENGINEER (24) seeks Situation in Electrical Works, good mechanical experience.—W. BONE, 95, Addison Gardens, London, W. 8532

ENGINEER (23), practical and technical training, steam and electrical, requires appointment in drawing office, provincial preferred.—8551, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

IMPROVER seeks berth; three years Lighting Station, good worker.—8519, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

IMPROVER-Electrician and General Mechanic requires situation. Age 19 years, five years' experience, with good references. Town or country.—Address, "A.," 23, Lanark Villas, Maida Vale, W. 8697

JOINTER.—H. and L. tension concentric cables, services, meters; good plumber and fitter. Change wanted.—8679, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MATE.—Respectable Young Man wants Job as Electrician's Mate; thorough knowledge of electrical supplies.—"E.," 9, Hardwicke Road, Acton Green, W. 8592

MECHANICAL and Electrical Engineer (26) desires position of trust; 10 years' experience in all modern manufacture, able to take control of men; estimating and pricing piecework; scientific instruments a speciality.—Apply "X.," 2, Garnies Street, Peckham, S.E. 8711

MOTOR (petrol) and Electrical Engineering.—Wanted to place smart youth, just completing three years' technical college course, as Improver or Apprentice.—3648, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PRIVATE Plant.—Electrical Engineer (23) wants Charge of Plant, steam, gas or oil engines, do own repairs; good references.—8482, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SURVEYOR and Assistant in Mains Department requires an appointment.—8518, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TO Consulting Engineers or Contractors.—Assoc.M.Inst.C.E., of good standing, is open to an engagement as Electrical Engineer with a first rank firm. Wide experience in leading position with important electric firm in this country and America. Would undertake management of department dealing with plant for electric equipment of tramways, railways, factories, or power distribution. Highest references.—Box 5210, Judd's, 5, Queen Victoria St., E.C. 8538

TWO Experienced men as Meter Repairers, could organise Meter Repairing Department.—"A. R.," 17, Sumner Road, Peckham. 8714

WANTED to place youth of 18 in generating station, Central or Southern District preferred.—"F. W.," 38, Fanthorpe Street, Putney. 8718

WIREMAN (23), good all-round, good references, moderate rate.—"ELECTRICIAN," 50, Brunswick Street, Poplar, E. 8732

WIREMAN, nine years' experience, all systems, disengaged.—"H. W.," 46, Formosa Street, Paddington. 8738

WIREMAN (competent) wants Job; Casing, Simplex. Rate 8d.—WIREMAN, 30, Pearson Street, Kingland Road, N. 8736

SITUATIONS WANTED.—*Continued.*

WIREMAN wants Job; Simplex, Casing or Barrel, town or country.—"W.," 41, Cassland Road, South Hackney. 8735

WIREMAN wants Engagement; Simplex, Casing.—"W. R.," 69, Upperton Road, Plaistow. 8740

WIREMAN, Simplex, casing, bells; town or country.—"H.," 31, Knight's Hill, West Norwood. 8710

WIREMAN seeks situation; lighting, bells, telephones; references.—"S.," 57, Alvington Crescent, Kingsland. 8644

WIREMAN (competent) seeks Situation; casing, Simplex, &c.—"S.," 5, Cremorne Road, Chelsea. 8692

WIREMAN, competent in all branches, wants Job.—F. BRICE, 11, Taunton Road, Lee. 8698

WIREMAN wants job, competent (age 26).—"N. C.," 1, Newnham Street, Marylebone. 8694

WIREMAN wants Job; good references. Casing, Tubing.—PHILLPOT.—15, Adley Street, Homerton. 8628

WIREMAN wants Job; conduit, casing, bells, telephones; references.—"F. H.," 17, Bouverie Street, Paddington. 8618

WIREMAN'S Assistant wants Situation, experience in light, power, bells.—"K.," 8, Warbeck Road, Shepherd's Bush. 8531

WIREMAN'S Assistant wants work.—"S.," B Block, 22, Lower Cross Road, Hampstead. 8586

WORKS Foreman, 15 years' continuous service in one position. Complete knowledge of switchboard, instruments, and similar work. Had sole charge of 150 to 200 hands. Excellent references.—GEORGE GARDNER, 10, Lorne Road, Walthamstow, Essex. 8422

YOUNG energetic Electrical Engineer, technical, practical and commercial experience, any capacity, moderate salary (own testing instruments).—"S.," 98, Leyland Road, Southport. 8672

YOUNG energetic Electrical Engineer seeks situation.—"S.W.," "Hazelwood," Tavistock Grove, W. Croydon. 8446

YOUTH (20), trained as premium pupil with firm of manufacturing electrical engineers, wishes for position as Improver under Chief Engineer on a central station. Not afraid of hard work in return for experience.—8486, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

2 WIREMEN, Simplex, casing, phones and bells, town or country.—"C. A., 23, Lucus Road, Kennington Park, S.E. 8417

AGENCIES.

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ADVERTISER, good Showroom facing street, principal thoroughfare, Newcastle-on-Tyne; successfully selling electrical speciality, first-class connections amongst trade, engineering firms, supply stations, shipbuilding yards, collieries, in Northumberland and Durham; requires one or two good lines to combine; English, German or American; no oils; expenses and commission; highest references given.—8451, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER, Electrical Engineer, commencing business on own account, smart and energetic, first-class connection amongst electrical contractors and wiremen, in large town in Scotland, seeks Agency for Electrical Accessories, Fittings, Motors, &c. Highest references given.—8444, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENTS.—Wanted a gentleman or well-established firm in each district to take up Agency for an English-made Incandescent Lamp. Bankers and Trade references required.—8712, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENTS wanted, having first-class connection among electrical contractors, to push sale of Special Accessories in London and country. Liberal commission.—Apply in first instance, stating ground covered, 8649, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(Continued on next page.)

FOR SALE.—*Continued.*

ARTICLES WANTED.—*Continued.*

PARTNERSHIPS.

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DIRECTOR (active preferred) required to invest £1000 in Company with sole manufacturing rights, can draw £3 weekly. —Apply for full particulars Messrs. TIMBRELL & DEIGHTON, Solicitors, 44, King William Street, London Bridge, E.C. 8416

OWNER of several Electrical Patented Specialities is desirous of meeting with a Gentleman who is capable of providing the necessary capital for opening business with same. Any equitable proposal for dealing with one or all of the Inventions would be considered. Every facility for the fullest investigation offered. —C. A. TACKLEY, Owner's Solicitor, 49A, Lincoln's Inn Fields, W.C. 8645

WANTED, a Partner, with £100 capital, for Contracting Business in South of England; good connection.—8669, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Partner to join established Contracting Business in London; capital required £100 to £250.—8731, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, £5000 to £6000 for the manufacture of Dynamos and Motors under a new patent; capital will be used entirely for the business, no part of which will be allotted for patents, &c.; the capital required will be a first charge of 6 per cent., after which the new partner (working or otherwise) will receive his share of remaining profits.—8529, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

BUSINESSES FOR SALE AND WANTED.

Re THE GOODFELLOW ENGINEERING CO., LTD., IN LIQUIDATION.

FOR SALE as a Going Concern, the Engineering Business carried on by the above company and now in full operation. The Works are well situated in Hyde, Cheshire, and comprise about 20,000 square yards of land, partly freehold and partly long leasehold, subject to ground rents amounting in the aggregate to £79 14s. 5d. per annum, situated conveniently near two branches of the Great Central Railway. The buildings comprise heavy and light Machine Shops, Smithy, Pattern Shop, Erecting Shop, with 40-ton Power Crane, Millwrights Shop, Brass Foundry, Electrical Winding Shop, Pattern and General Stores, Offices, Timekeeper's Cottage, Stables, &c., together with a large and extensive plant suitable for high-class Engines and Millwrighting work. For further particulars and orders to view, apply to Messrs. DAVID SMITH, GARNETT & Co., Chartered Accountants, 22, Booth Street; Messrs. BAYLEY, WOOD & Co., Chartered Accountants, 6, Booth Street; Messrs. GOULTY & GOODFELLOW, Solicitors, 37, Brown Street; and Mr. ROBERT INNES, Solicitor, 10, Norfolk Street; or to Messrs. WHEATLEY KIRK, PRICE & Co., 16, Albert Square—all of Manchester. 8594

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ELECTRICAL Contractor's Business. Western suburb, well situated; good shop, well stocked. Open to fair offer.—8624, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TO Electrical Engineers.—For Disposal by Private Treaty, a well-equipped Works, with large connection among Corporations, with valuable Licence if required; moderate capital only necessary; a most favourable opportunity for electrical engineer of securing a good, well-established business.—For particulars and to view apply to WILLIAM HANCHETT, Solicitor, Guardian Buildings, Manchester. 8619

FOR SALE.

Re THE CLIFT MANUFACTURING CO., LTD. (In Liquidation).

FOR SALE.—The Plant, Fittings, Machinery and Stock-in-Trade of the above Switchboard Manufacturing concern carried on at Bravington Road, Paddington, W.

The Works are thoroughly up-to-date and the Machinery of modern design electrically driven. Reasonable terms can be arranged.

For further particulars apply

HARPER & BROOM,
Incorporated Accountants,
27, Chancery Lane, W.C. 8715

FOR SALE.—*Continued.*

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Box Number and ELECTRICAL REVIEW address count as seven words.

CABLES.—About 50 miles Cables, all sizes, to be disposed of quickly, at 50% off Non-Association prices. English made. —Send at once to the MANCHESTER ELECTRICAL FITTINGS Co., Caxton Hall, Chapel Street, Salford. 8653

CENTRAL Station Engineers.—A unique opportunity. Two new undertype Dynamos, Fields, Armatures and Bearings, ready for mounting on base plate to form balancer, 240 to 280 volts, 900 to 1100 speed, 100 to 150 amperes. Price £50. The two sets, nett cash, on premises, cost £220.—MITCHELL, 51, Wilson Street, Finsbury Square, London, E.C. 8726

DRY and Export Renewable Batteries for Pocket, Torch and Hand Lamps, also Electrical Novelties, can now be obtained from T. A. ROSE & Co., 56 and 57, Aldermanbury, London, E.C. (sole Agents for Schmidt & Co.'s world-renowned Batteries). 8404

DYNAMO, 40 amperes 100 volts, good maker, perfect order, £13.—MARTIN, Electrical Engineer, Kidderminster. 8539

EVERSHED'S Portable Testing Set, 200 volts (new), £12.—GARDINER BROS., Bath Road, Hounslow. 8670

FOR Sale.—600-KW. Steam Generator, by Tynemouth Corporation, owing to their having arranged for a Bulk Supply:—Belliss & Morcom Engine, coupled to Siemens Dynamo. Might be sold separately if necessary. This magnificent Plant is absolutely new and can be seen, by appointment, at respective makers' works.—For further details apply to Mr. C. TURNBULL, A.M.I.E.E., Electricity Works, North Shields. 8242

FOR Sale, (two) 20 KW. Belliss & Morcom Engine, direct-coupled to a D.C. Siemens Dynamo, 110 volts 200 amperes, 375 r.p.m., can be seen at work; cheap, immediate clearance.—WILLIAMS & SONS, South Bermondsey Station, London. 8607

FOR Sale 150 KW. Steam Alternator, by the Brush Engineering Co., 2000 volts, 100 periods, 200 r.p.m. Can now be seen working under full load; a bargain, to save removal.—WILLIAMS AND SONS, Engineers, South Bermondsey Station, London. 8608

FOR Sale, 40-KW. Steam Dynamo, 200—220 volts, forced lubrication throughout, can be seen working under full load, immediate sale, room wanted.—Apply, 8604, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR Sale, 80-KW. Parsons Steam Turbo Generator, 110 to 130 volts, can be seen working under full load, must be cleared within 14 days.—Apply, 8605, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR Sale, 25-H.P. Motor Enclosed D.C. 220 volts 700 r.p.m., also 15-H.P. enclosed Motor by Verity's, 400 volts, both fitted with driving pulley and slide rails, cheap.—Apply, WILLIAMS & SONS, South Bermondsey Station, London, S.E. 8606

FOR Sale. — Armature Disc-Cutting and Notching Plant:—240-I.H.P. Willans & Robinson Engine, with Brush Dynamo, 240 volts; 50-KW. Turbo Alternator (by Parsons), 2000 volts; three Babcock & Wilcox Marine Type Boilers, capacity each 3500 lbs. water per hour, insured 150 lbs. pressure. Catalogue descriptive of 2000 lots free on application. Machinery let out on hire or sold on purchase-hire; inspection invited.—THOS. W. WARD, LIMITED, Albion Works, Sheffield. Telegraphic Address: "Forward, Sheffield." 7243

FOR Sale or Hire, high-class Dynamos, Motors, Alternators, Cable and Arc Lamps.—PERCY HUDDLESTON & Co., 72, Finsbury Pavement, E.C. 7902

FOR Sale.—Two-pole Shunt-wound Dynamo, 75 amps. 110 volts. 915 revs., slide rails but no pulley; in good condition; makers Mavor and Coulson.—Apply, WATSON, LAIDLAW & Co., 98, Dundas Street, Glasgow, S.S. 8441

FOR Sale.—Direct-coupled Petrol Engine and Dynamo, output 18 amps. at 100—140 volts, at 1000 r.p.m.; condition as new. Seen running by appointment.—NICHOLSON & Co., Cannon Street, Manchester. 8701

GLASS Shades for Electric Lighting in every variety of design and colour.—JOHN WALSH WALSH, Glass Manufacturer, Birmingham. 5778

INCANDESCENT Lamps, 230 volts, 32 C.P., 4" bulb. Burnt on an average 700 hours. What offers per 100 or 1000 lots? London district.—8558, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

LARGE new Engine and Dynamo—engines, compound inverted type, with 2 H.P. cylinders, 10" dia., and 2 L.P. cylinders, 18 in. dia., uniform stroke of 9 in. Dynamo is compound wound, 220 volts, 800 amps.—BROWN, BROWN & Co., Victoria Mills, Chesterfield. 8555

(Continued on next page.)

FOR SALE.—*Continued.*

MOTOR (Crompton Three-Bearing Type), 30 H.P., 200/250 V., 500 r.p.m., series wound, with spare armature.—MARTIN, Electrical Engineer, Kidderminster. 8646

MOTOR, 15-H.P. 220 V. 800 r.p.m., by B.T.H. Co., shunt wound.—MARTIN, Electrical Engineer, Kidderminster. 8574

NEW Electric Light Wires and Cables, 300 megohm grade, English make: 1/18, £4 15 0 per mile; 1/16, £5 15 0 per mile; 3/22, £5 15 0 per mile; 3/20, £7 15 0 per mile; 3/18, £9 15 0 per mile; 7/22, £7 15 0 per mile; 7/21½, £8 15 0 per mile; 7/20, £10 15 0 per mile; 7/15, £33 0 0 per mile; 19/14, £95 0 0 per mile.—LAKE, 132, Upper Thames Street, London, E.C. 8573

OHMMETER and Generator by Evershed & Vignoles, 500 volt 50 megohms, spring drum attachment, as good as new. Would accept £13 15s.—8713, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PRODUCER Gas.—Engine and Plant, Tangye's latest type, 17½ B.B.P., fitted with self-starter; absolutely new and perfect; only run 80 hours on experimental plant, complete with all piping and valves; seen working Hampshire; price £125.—"ENGINEER," Dodworth Grange, Barnsley. 8722

THE following two-pole, two-bearing original type "Taunton" Dynamos For Sale, good as new and guaranteed:—

One 200 volts 13 amps. 1350 revs., £14.
One 150 volts 33 amps. 1200 revs., £17.
One 140 volts 35 amps. 1410 revs., £17.
One 150 volts 45 amps. 1100 revs., £21.
One 220 volts 300 amps. 600 revs., £135 (3 bearings).
One 100 volts 2 B.H.P. 1300 revs., £7.

—Apply, BAXTER & CAUNTER, 86, Charing Cross Road, London. 8200

WANTED to sell Electric Plant in first-class condition, consisting of Dynamo, 17½ kilowatts, 110 volts, speed 780; Crossley's Gas Engine (three tanks) 28 B.H.P., exhaust box and silencer, self-starter, and switchboard complete: eight new Jandus Arc Lamps, and 20 old type. Only reason, changing to higher voltage. Can be seen working 12th to 18th March.—NEW SPA AND GARDENS, LTD., Bridlington. 6982

2 B.H.P. Gardner Gas Engine, Tank, Gas Bag, Silencer. In perfect condition. £13. A bargain.—THOMPSON, 28, Deptford Bridge, Greenwich. 8559

ARTICLES WANTED.

WANTED TO PURCHASE FROM ELECTRIC LIGHTING Companies and Electrical Engineers, old and obsolete Dynamos, Motors, Cable, Wire, Instruments, and every description of Electrical Material, also Manufacturers' Surplus Stocks. The bulk being for re-use, high cash prices can be paid.—A. VEREY AND CO., Dover. Principal in London three days a week. Telegraphic Address: "Verey, Dover." 8514

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A.—TO Electric Lighting Companies and Others.—J. T. WILLIAMS & SONS, Engineers and Metal Merchants, South Bermondsey Railway Station, London, S.E., are cash purchasers of Engines, Boilers, and good Electric Plant for re-fixing; also old obsolete Dynamos, Accumulators, Cable, Scrap Iron and Loose Metals, &c. Prompt attention. National Telephone 884 Hop. 6476

ACCUMULATORS, Second-hand, any type, wanted; also Dynamos and Machinery, Lead Peroxide, Old Copper Cable, Scrap Metals, and every description of Metallic Dross purchased for cash, town or country.—Write, A. BROWN & SONS, 142, Lower Clapton Road, N.E. Telephone: 1355 North. Late of 77, Lansdowne Road, Dalston. 3781

COPPER, Mica Borings, also Gun-metal and Borings. State quantity and price, cash, to 8303, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

OLD Electric Cable, Dynamos, Machinery, Accumulators, Scrap Metals, or any Electrical Machinery purchased for cash in town or country.—Apply to I. LEVY & SONS, 62, Albany Road, Old Kent Road, S.E. Telegraphic Address: "Levisomnus, London." Telephone No. 1747 Hop. 7886

OLD Electric Lamp Ends, Cable and Wire bought for cash.—SMITH & Co., 2, Ranelagh Road, East Ham, London, E. 2818

PLATINUM, in any form and quantity, purchased at highest prices by DERBY & Co., LTD., 44, Clerkenwell Road, London. 6522

WANTED.—Electric Lamp Tops and Scrap Platinum.—EDEY AND Co., 29, Ludgate Hill, London. 7769

ARTICLES WANTED.—*Continued.*

WANTED, Old and Obsolete Arc Lamps, any make or quantity, complete or incomplete; 2s. to 5s. each.—A. VEREY & Co., Dover. 8509

WANTED, a secondhand Boiler, preferably water-tube type, about 1035 sq. ft. heating surface, 150 lbs. working pressure.—Send full particulars and price to 8657, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, 13-H.P. 200 or 400-volt Motor, preferably Electromotors manufacture.—8720, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED.—One Second-Hand Dynamo to develop 70 to 80 H.P. at a speed of about 600 to 700 r.p.m. 500 volts. Must be in good condition.—ANDERSON, BOYES & Co., LTD., Flemington Electrical Works, Wishaw. 8703

PREMISES & SITES TO LET OR WANTED AND FOR SALE.

FULLER, HORSEY, SONS & CASSELL
Make a speciality of the Sale and Letting of
FACTORIES, WHARVES, AND WAREHOUSES.
REGISTER Forwarded on application.
Offices: 11, Billiter Square, London, E.C. 8317

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FACTORY Premises (with power) to be Let, including machine shop (35 ft. by 14 ft. 6 in.), two workshops (each 31 ft. by 14 ft.), and office, with rooms over, 6 H.P. (nominal) Gas Engine with Line Shafting. Rent £75.—Apply to E. & T. PINK, Staple Street, Borough. 8625

TO Motor Engineers and other Trades.—Factory at Walworth to be Let or Sold. Two entrances. Large ground area, all covered. Free water from own well.—Apply BROWETT & TAYLOR, Surveyors, 9, Warwick Court, Holborn, W.C. 8637

MISCELLANEOUS.

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A.M.I.C.E. Exam., private coaching, twelve or six months' course optional; subjects selected specially for Electrical Engineers.—Apply "A.M.I.C.E.," 180, West Regent Street, Glasgow. 8452

A MANUFACTURING Firm (London), are open to take up the manufacture of any Electrical or other Speciality, or to manufacture goods for the trade. High class work, competitive prices.—Apply 8434, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DESIGNING Engineer, A.I.E.E., with considerable experience in automatic electro-magnetic apparatus of every description is open to undertake experimental work or to re-design and cheapen existing gear. Inventions worked out in private workshops and test rooms.—7577, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

EPSTEIN Accumulator Plates for Storage Batteries are now supplied by the sole licensees and makers, W. O. ROOPER AND Co., Electrical Engineers, Stafford. 80

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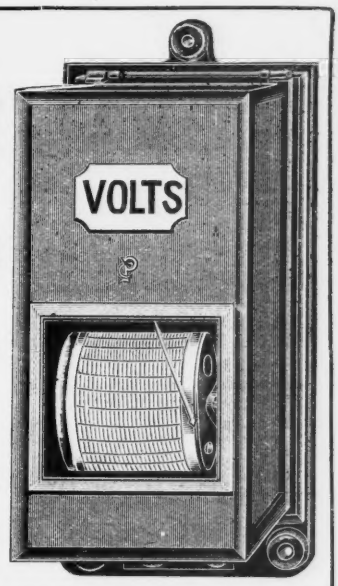

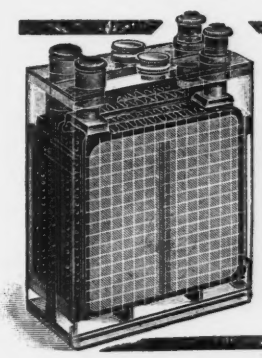

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See Illustrated Advertisement last week.

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Owing to the many hundreds of replies passing through this Office each week, we would ask those answering Advertisements to be extremely accurate in giving the correct figures when addressing replies to Box Numbers.

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BINDING AND CASES.—Subscribers and others can have their half-yearly numbers bound handsomely in Black Cloth at the rate of 4s. per volume. Cases for binding are also supplied at 2s. 6d. each.—4, Ludgate Hill, London.

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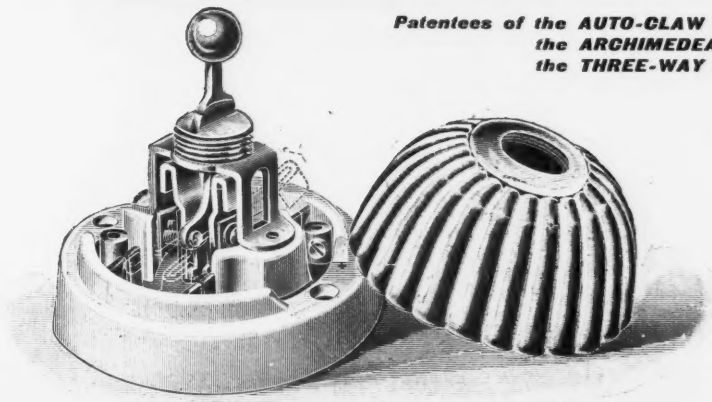

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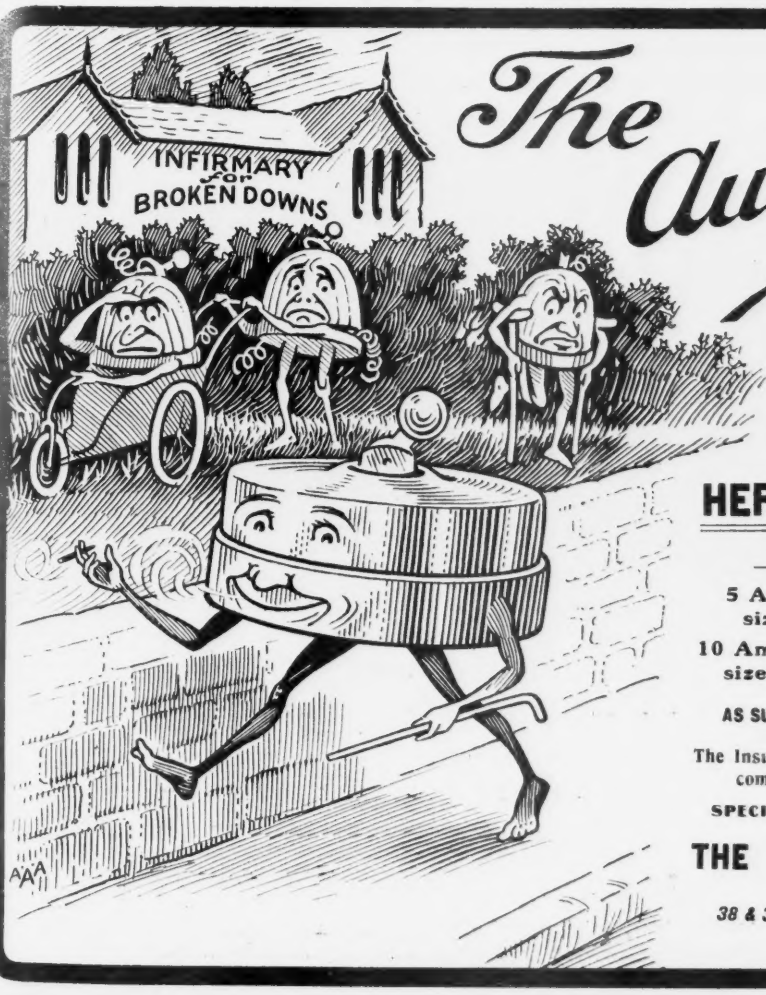

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Official Notices.

TWICKENHAM URBAN DISTRICT COUNCIL.

Sewage Disposal and Refuse Destructor Works.

Contract "G."—Electric Lighting, &c.

THE above Council invite Tenders for the Electric Lighting and Supply of Electrical Machinery, &c., at the Pumping Station and Destructor Buildings, Sewage Disposal Works, The Mereway, Twickenham.

Specifications and Forms of Tender may be obtained, and Drawings inspected, at the office of Mr. WILLIAM FAIRLEY, Consulting Engineer to the Council, 69, Victoria Street, Westminster; also, on application to Mr. FRED W. PEARCE, Surveyor to the Council, Town Hall, Twickenham, on deposit of a crossed cheque for Two Guineas, made payable to the Council, which deposit will be returned on receipt of a *bona-fide* Tender.

Sealed Tenders, on the Forms supplied by the Council, to be delivered to the undersigned on or before noon on WEDNESDAY, the 11th day of JULY, 1906.

The Council do not bind themselves to accept the lowest or any Tender.

By Order,
H. JASON SAUNDERS,
Clerk to the Council.

20th June, 1906.
Town Hall, Twickenham. 8637

BOARD OF PUBLIC WORKS.

TENDERS for certain Electric Works at the Royal Irish Academy House, Dawson Street, and at the Science and Art Buildings, and Leinster House, Kildare Street, Dublin, will be received up to, but not later than, 10 a.m. on the 9th day of July, 1906.

The Plans and Specification can be seen at this office, where also Forms of Tender may be obtained.

The envelope containing the Tenders must be endorsed; and the Board will not be bound to accept the lowest or any tender.

By Order,
H. WILLIAMS,
Secretary.

Office of Public Works,
Dublin, *June 26th*, 1906. 8682

Official Notices.—*Continued.*

COUNTY BOROUGH OF BOLTON.

ELECTRICITY DEPARTMENT.

THE ELECTRICITY COMMITTEE of the Bolton Corporation invite Tenders for the Supply, Delivery, and Erection of Condensing Apparatus.

Specification and Form of Tender may be had on application to Mr. ARTHUR A. DAY, A.M.I.C.E., M.I.E.E., Borough Electrical Engineer and Tramways General Manager, Spa Road, Bolton, on and after 23rd June instant.

Tenders, endorsed "Condensing Apparatus," to be addressed to the Chairman of the Electricity Committee, Town Clerk's Office, Town Hall, Bolton, and must be delivered not later than 12 o'clock noon on JULY 12th, 1906.

The Committee do not bind themselves to accept the lowest or any tender.

SAMUEL PARKER,
Town Clerk.

Town Hall, Bolton,
June 16th, 1906. 8683

CORPORATION OF DUBLIN.

THE LIGHTING COMMITTEE of the Corporation of Dublin are prepared to receive Tenders for the Supply of

Sub-Station Switchboards and Accessories.
Transformer Pillars.

Specifications, with General Conditions and Form of Tender, can be obtained from the CITY ELECTRICAL ENGINEER, Fleet Street, Dublin, on and after June 28th, 1906, on payment of One Guinea for each Specifiation, which will be returned on receipt of a *bonâ fide* tender.

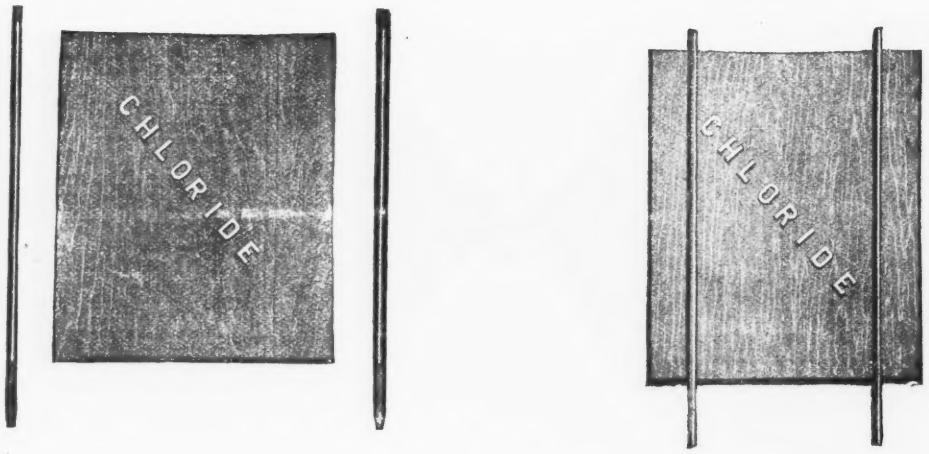
Tenders, addressed "Chairman of the Lighting Committee, 3, Cork Hill, Dublin, and marked "Tender for Sub-Station Switchboards, Transformer Pillars, &c.," to be delivered not later than MONDAY, JULY 9th, 1906.

FRED. J. ALLAN,
Secretary.

June 25th, 1906. 8665

(Continued on page 37).

OUR WOOD DIAPHRAGM SEPARATOR



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Official Notices.—*Continued from page 85.*

METROPOLITAN BOROUGH OF HACKNEY.

Electricity Works.

THE COUNCIL of the Metropolitan Borough of Hackney are prepared to receive Tenders for the following :—

SPECIFICATION No. 27
- SECTION A.—Arc Lamp Pillars.
- SECTION B.—Erection of Arc Lamp Pillars and Switch Pillars.
- SECTION C.—Arc Lamps and Accessories.
- SECTION D.—Switch Pillars.

General Conditions, Specification, Drawings, Form of Tender, and Form of Agreement may be inspected at the offices of Mr. ROBERT HAMMOND, M.Inst.C.E., the Consulting Engineer to the Council, 64, Victoria Street, Westminster, S.W., and may be obtained there on and after Monday, July 2nd, 1906, on making a deposit of £5, which sum will be refunded to *bonâ fide* Tenderers, after the Tenders have been adjudicated upon. Extra copies of the specification may be obtained by *bona fide* Tenderers at a charge of 5s. per copy, which sum will not be refunded.

Tenders (sealed and marked "Tender for Arc Lighting Apparatus") must be addressed to me at the Town Hall, Hackney, and be delivered on or before 4 p.m. on THURSDAY, JULY 26th, 1906.

The General Conditions of the proposed Contract will contain a Clause providing that the Contractor shall pay to all workmen wages at rates not less, and observe hours of labour not greater than those recognised by the various trades unions and in practice obtained in the district where the work is produced or executed.

The Council do not bind themselves to accept the lowest or any Tender.

W. A. WILLIAMS,
Town Clerk.

TOWN HALL, Hackney,
June 27th, 1906. 8692

COUNTY BOROUGH OF WEST HAM.

ELECTRICITY DEPARTMENT.

Tender for Cable and Transformers.

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Forms of Tender, and further particulars, may be obtained on and after the 30th inst., of the ENGINEER AND MANAGER, 84, Romford Road, Stratford, E.

Tenders to be enclosed in endorsed envelopes, supplied with the forms, and sent to my office not later than 5 o'clock on FRIDAY, JULY 13th, 1906.

The Council do not bind themselves to accept the lowest or any tender. The contractor will be required to enter into a bond with sureties for the due performance of the contract, and no goods, materials, &c., will be ordered under any contract until such bond has been duly executed.

The contractor whose tender is accepted, and with whom a contract is entered into, will be required to pay to the whole of his workmen such rate of wages, and observe such hours of labour, as are recognised by the workmen's trade unions and in force at the time of signing the contract. In the event of any breach of such agreement the Council will enforce the penalty clause in its entirety.

By order of the Council,
FRED. E. HILLEARY.
Town Clerk.

Town Hall.
West Ham, E.,
27th June, 1906. 8730

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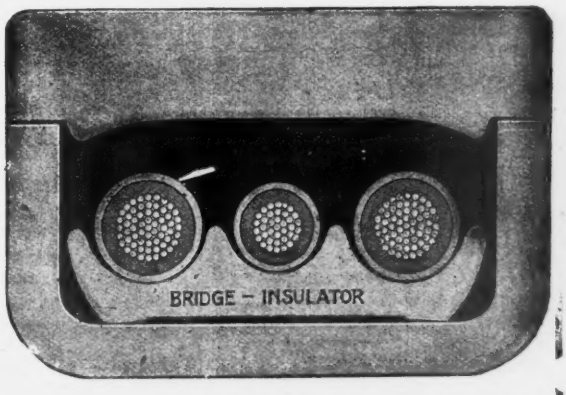

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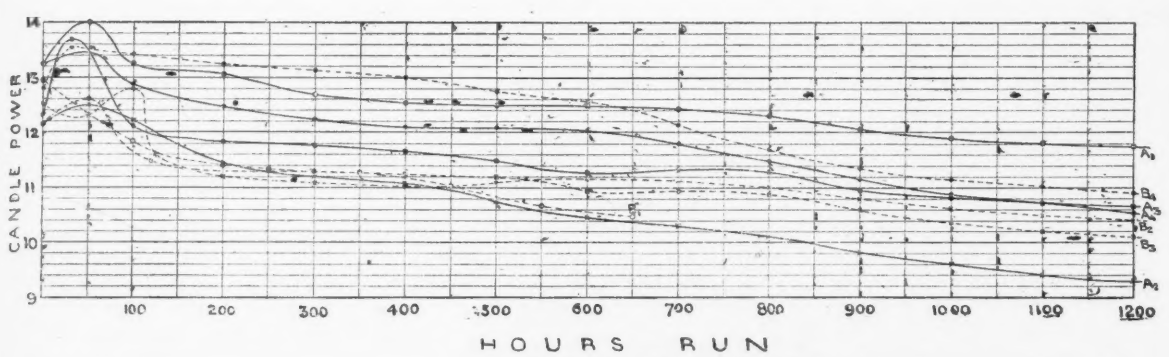

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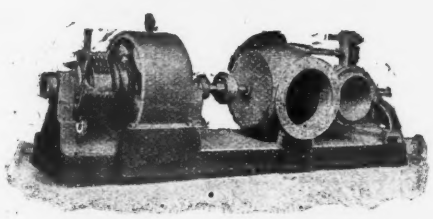

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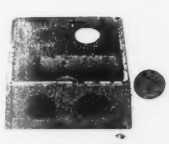

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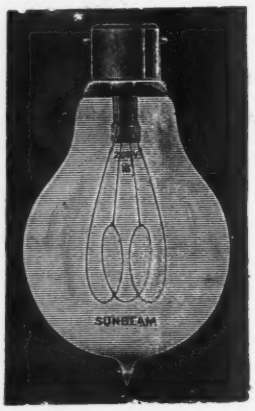

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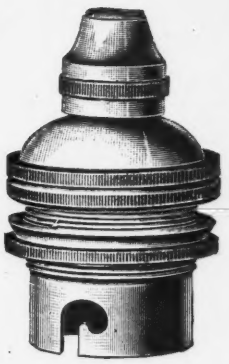

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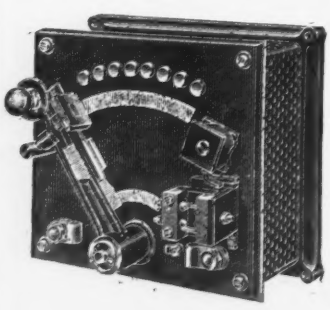

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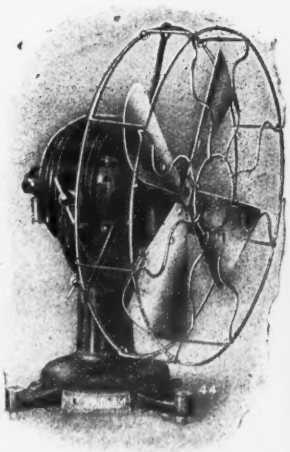

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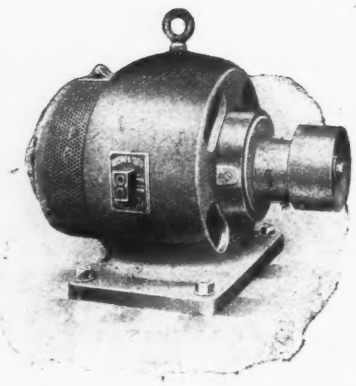

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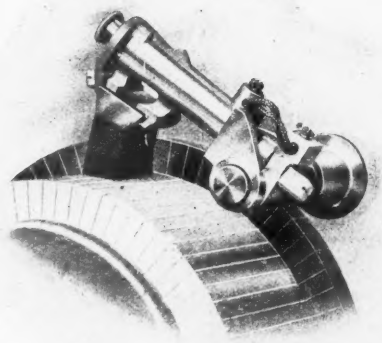

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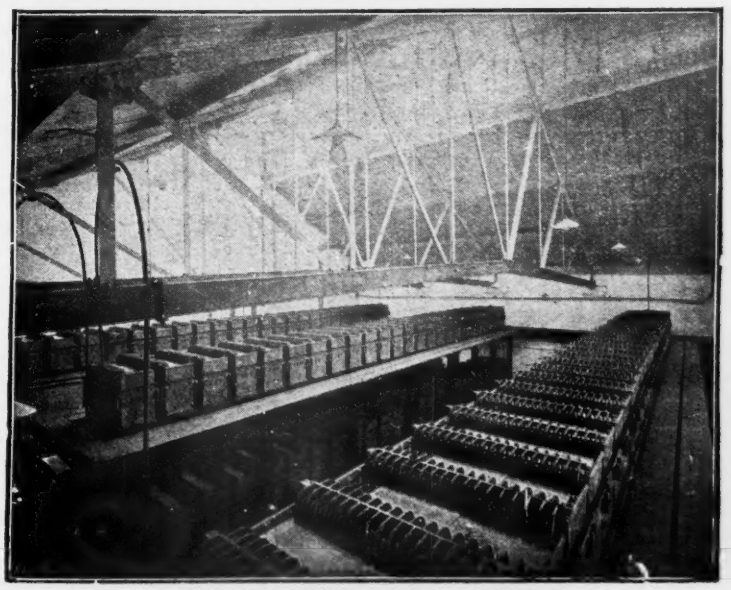

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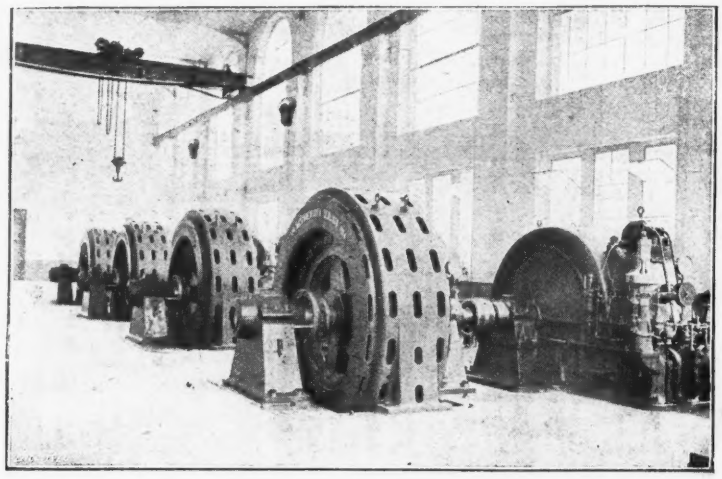

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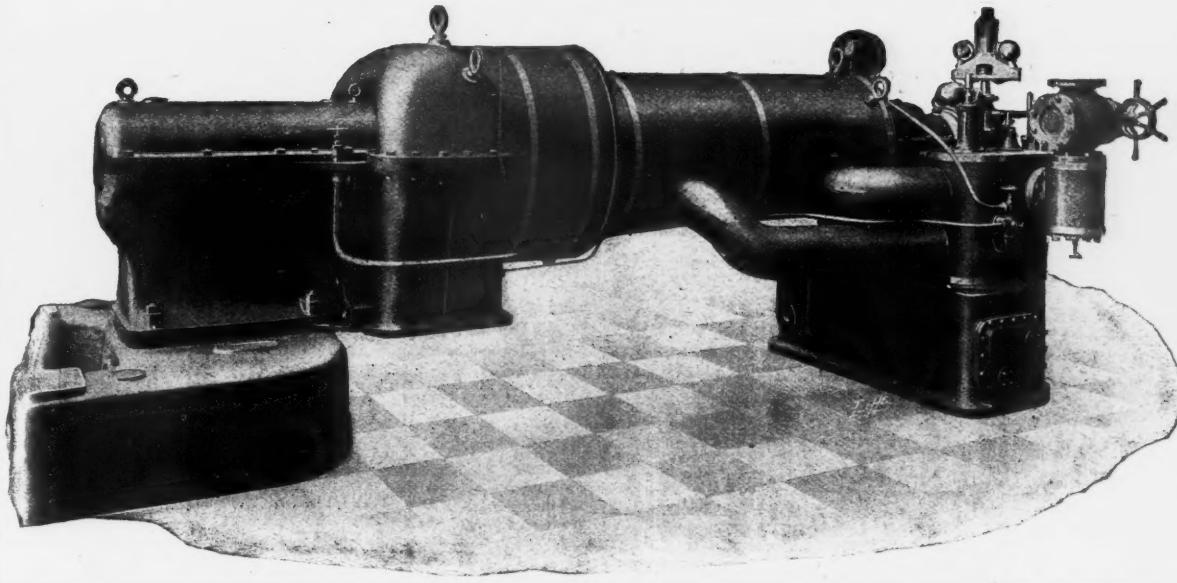

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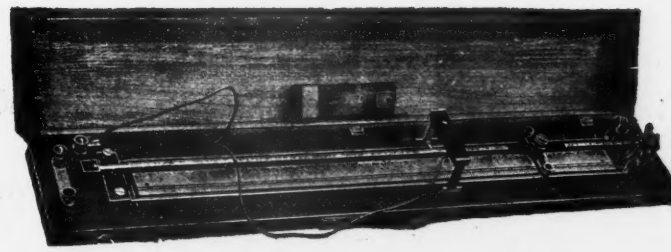

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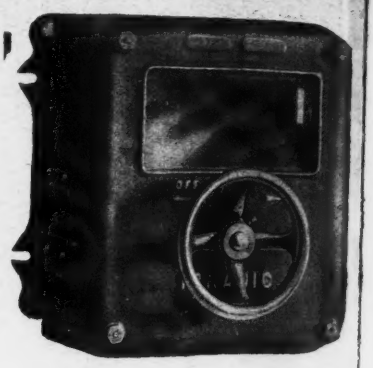

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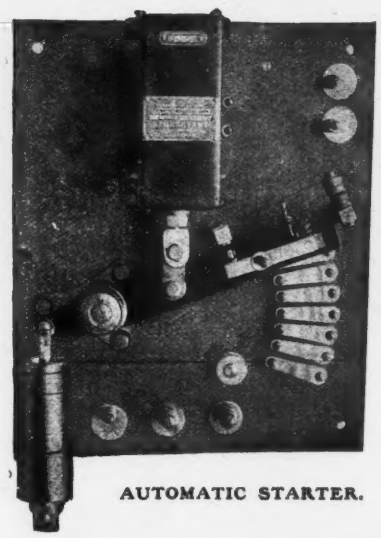

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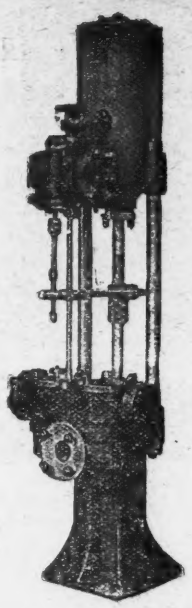

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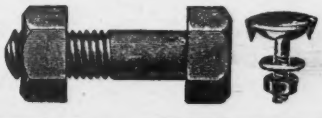

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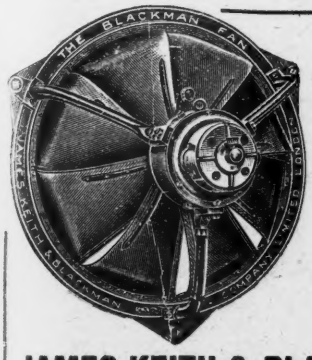

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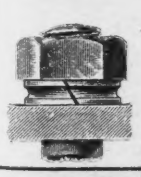

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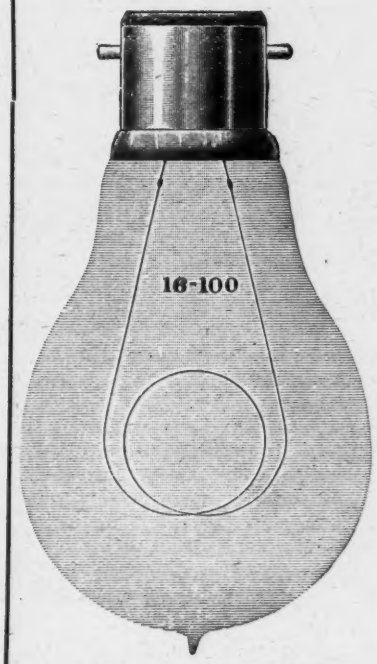

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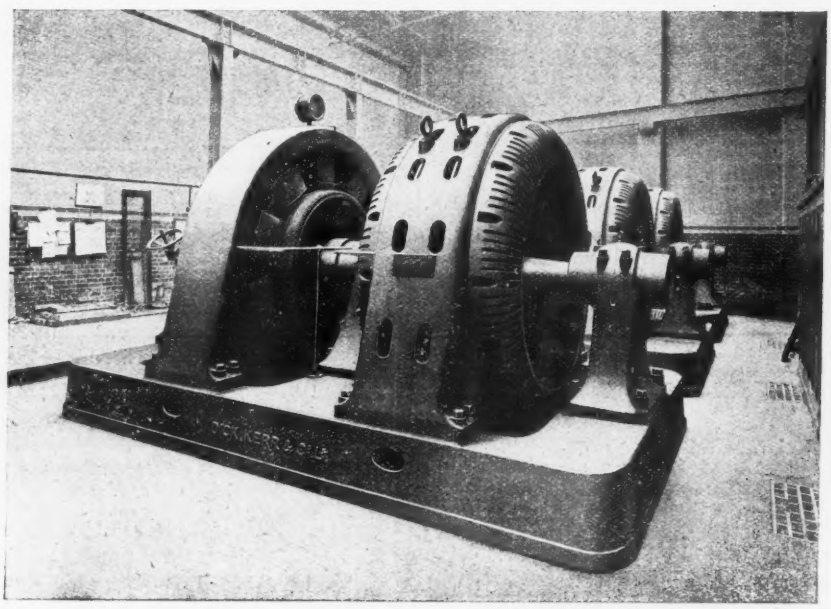

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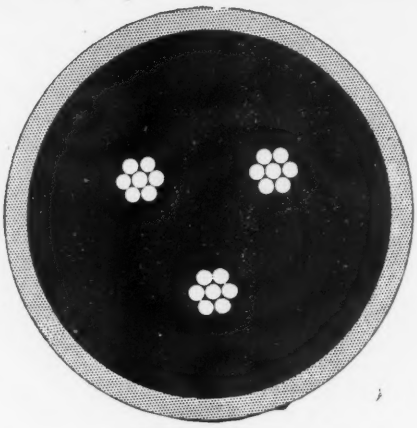

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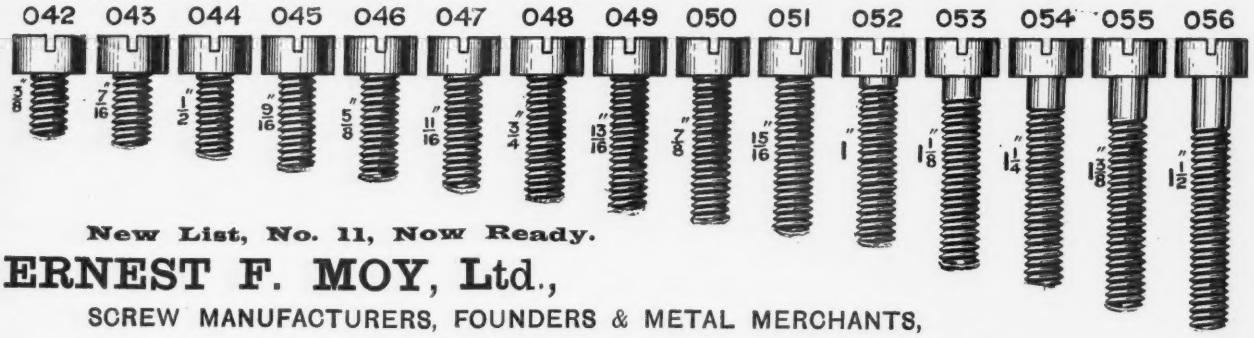

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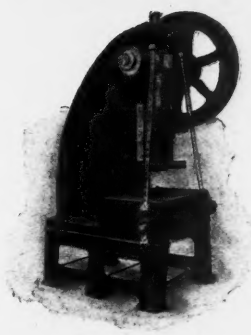

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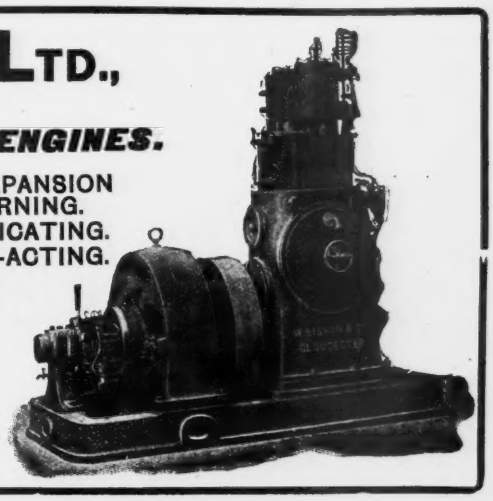

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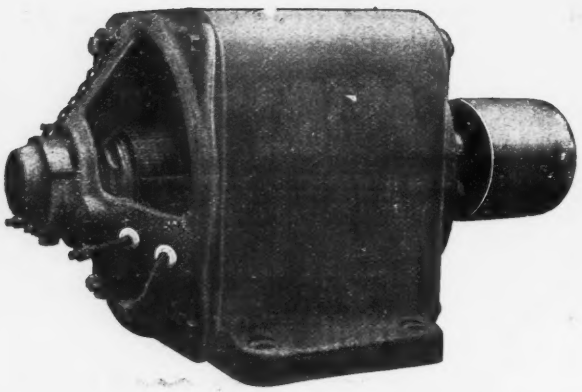

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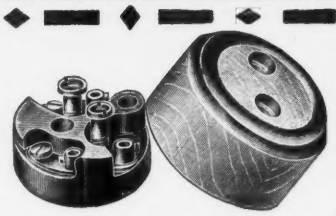

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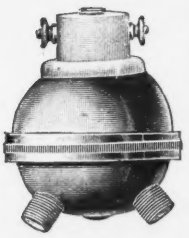

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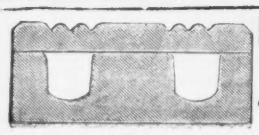

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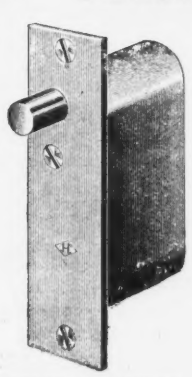

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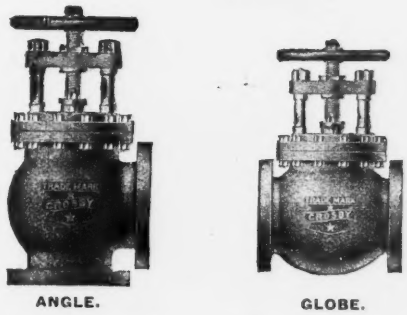

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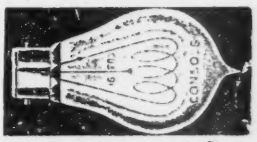

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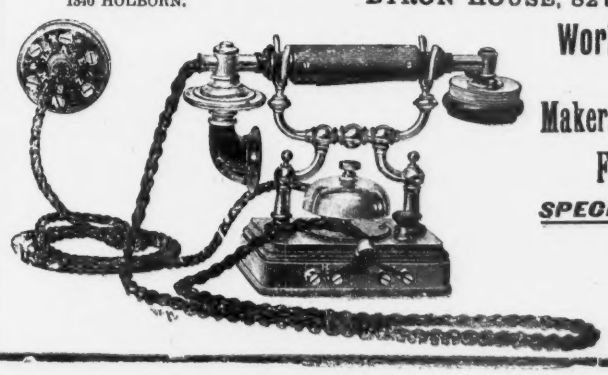

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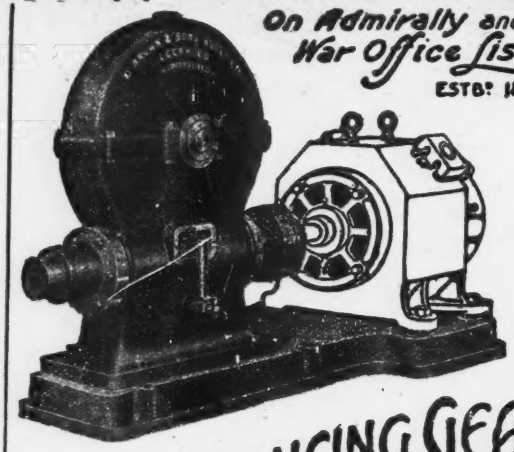

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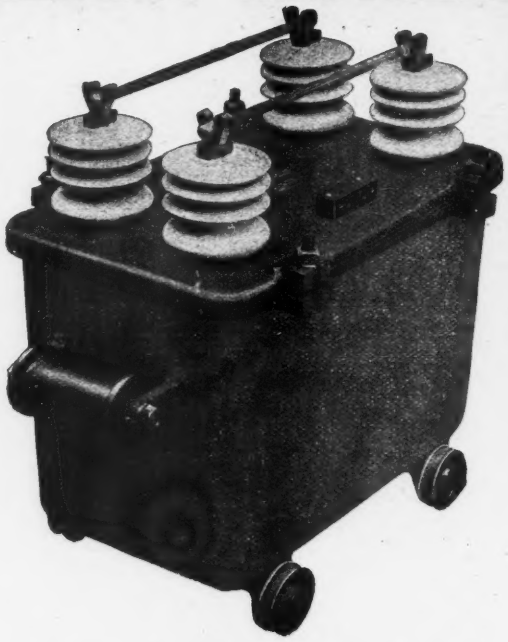

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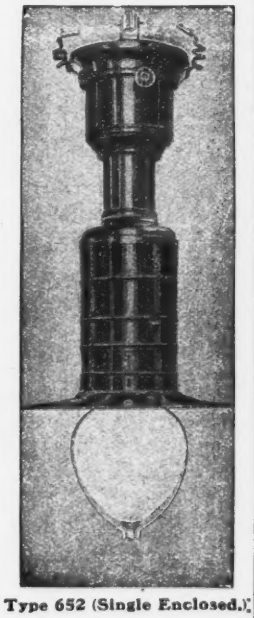

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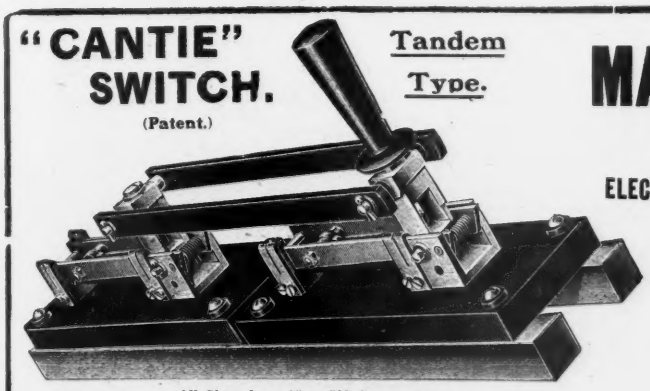

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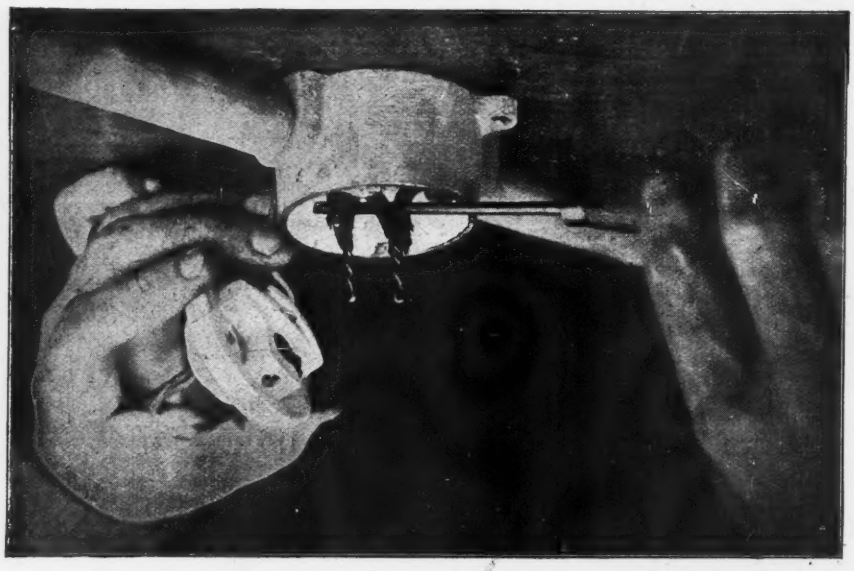

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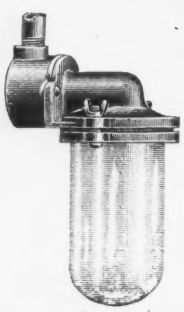

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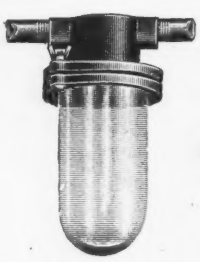

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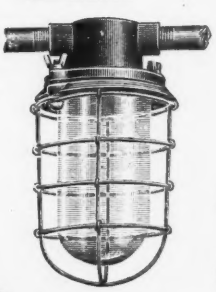

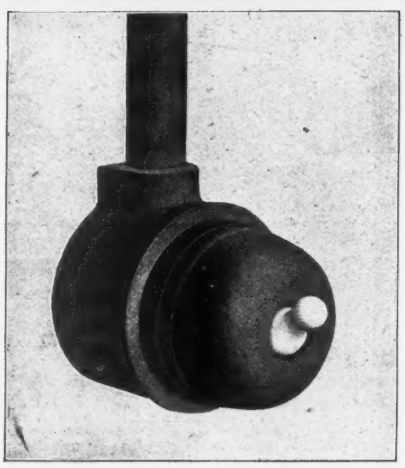

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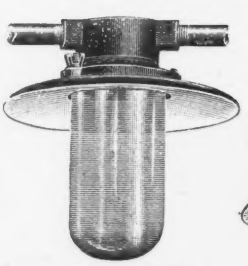

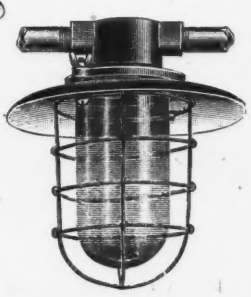

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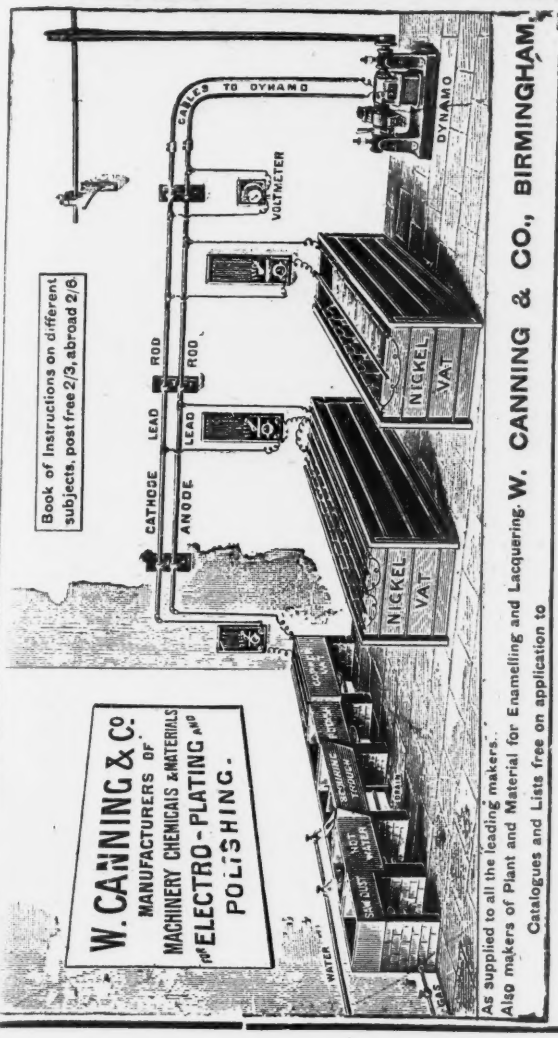
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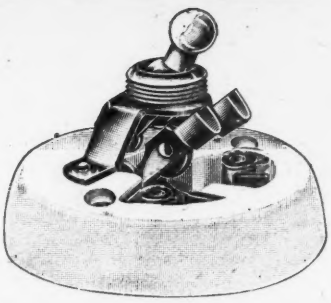

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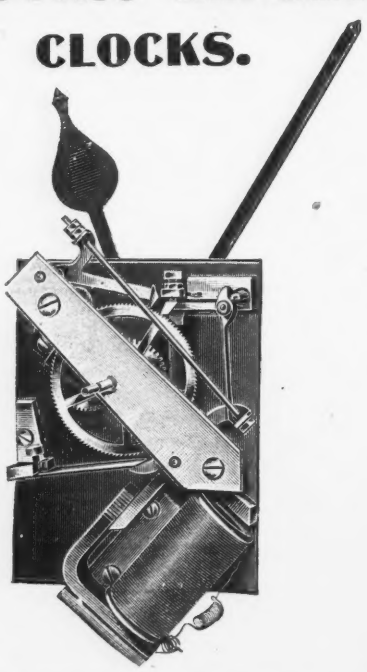

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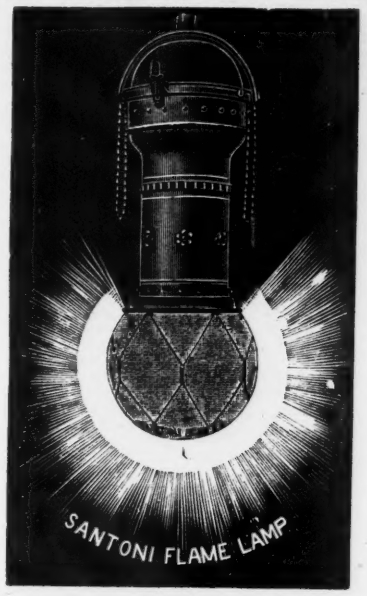

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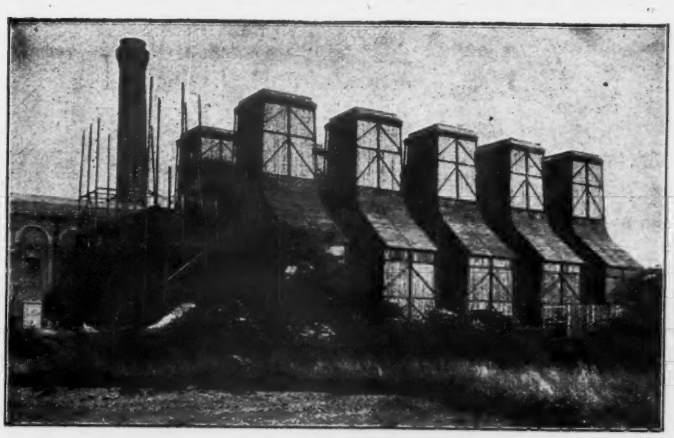

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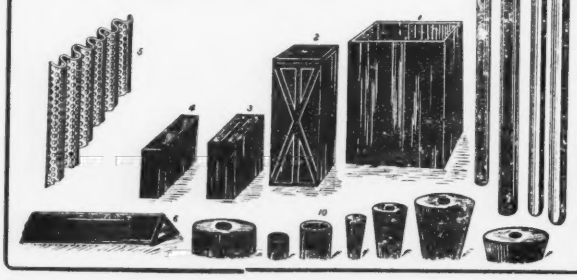

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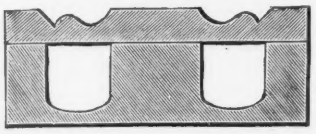

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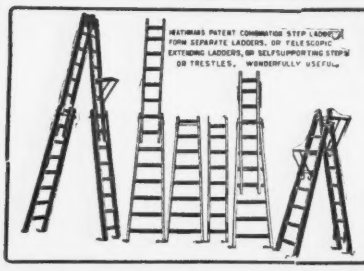

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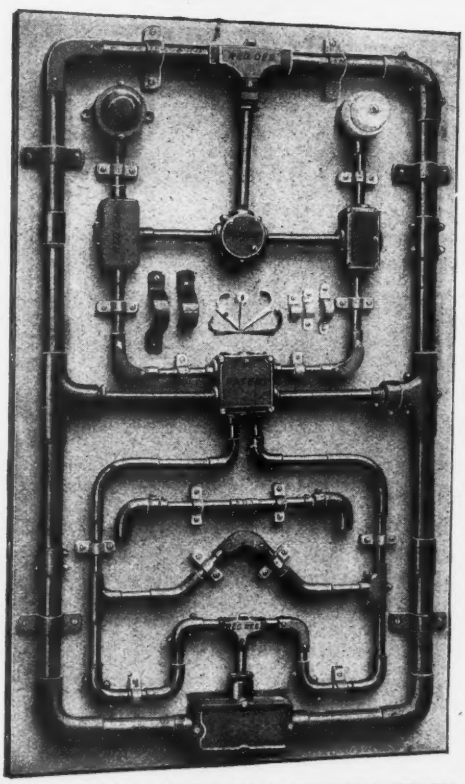

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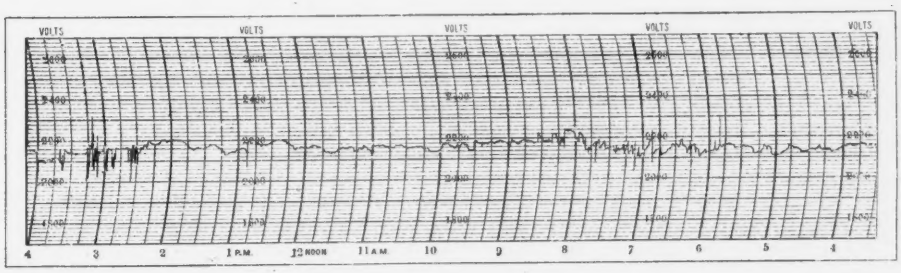

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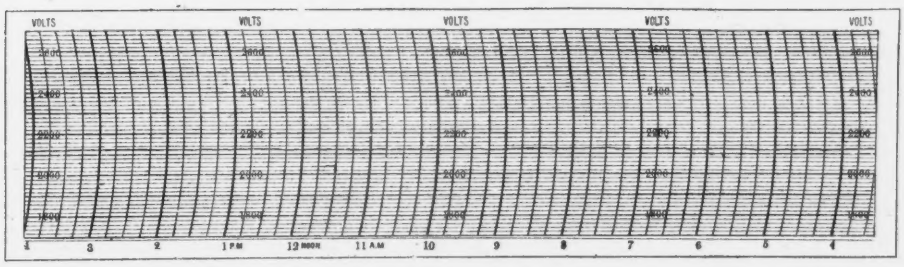

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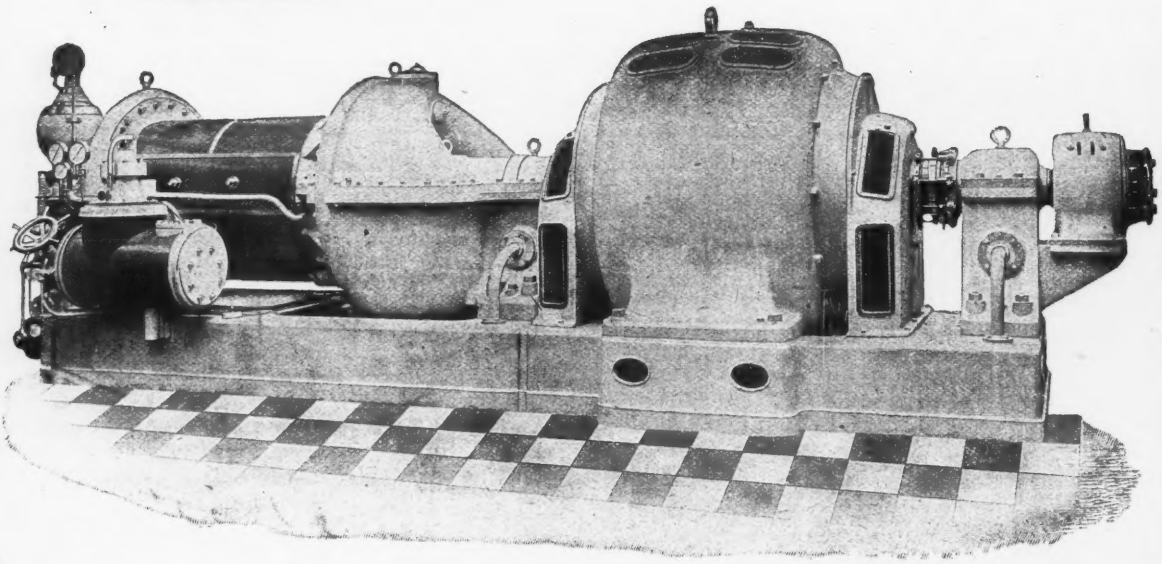

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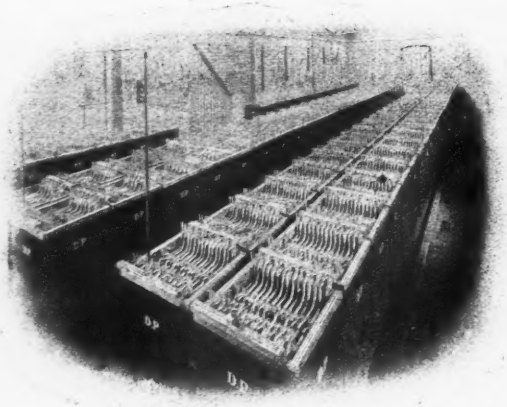

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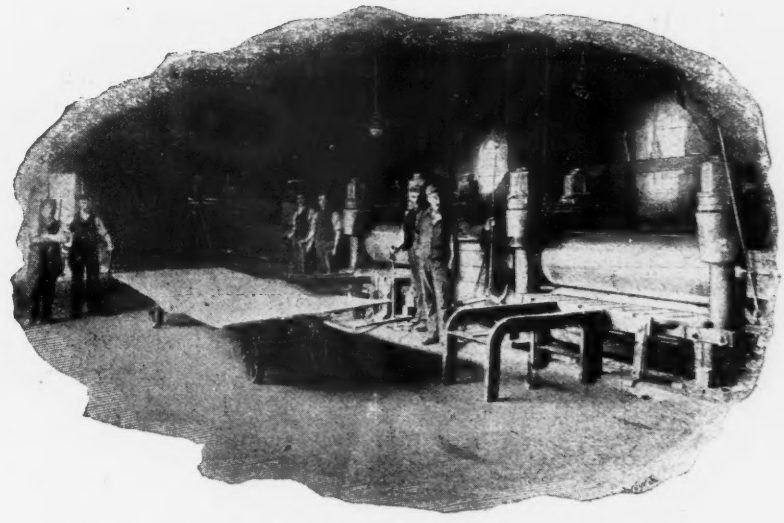

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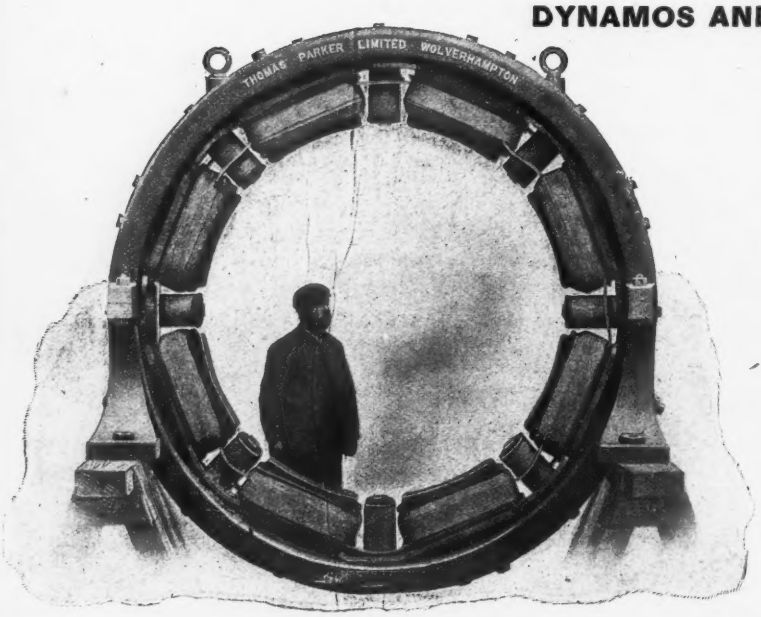

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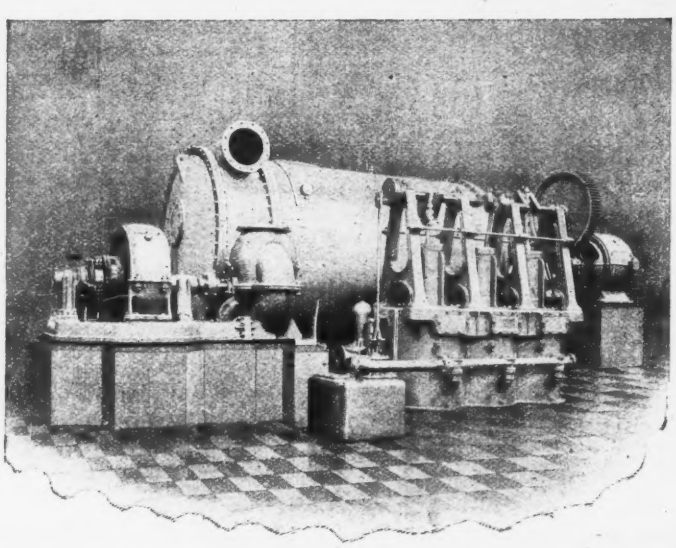

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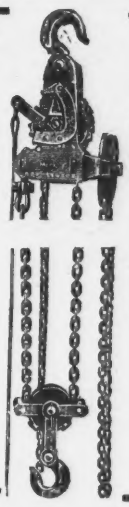

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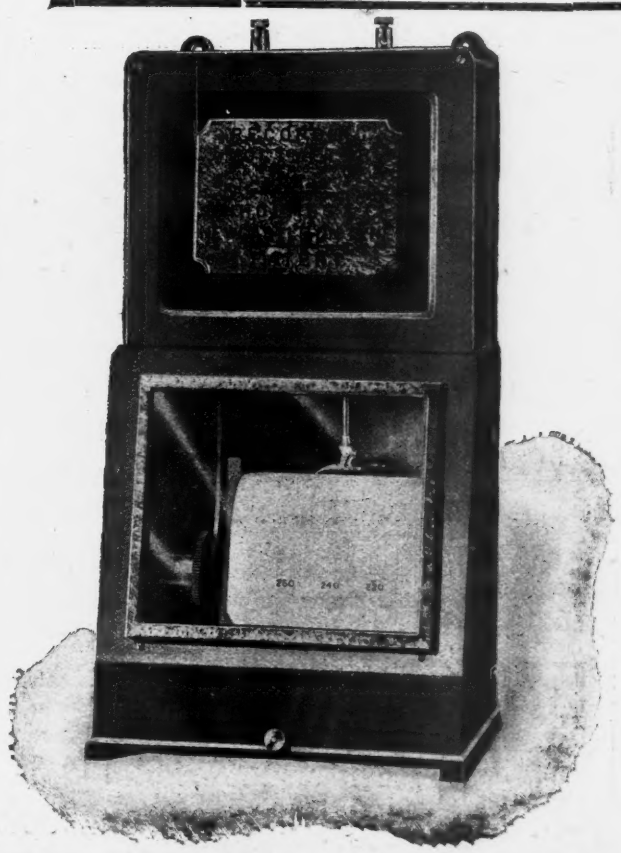

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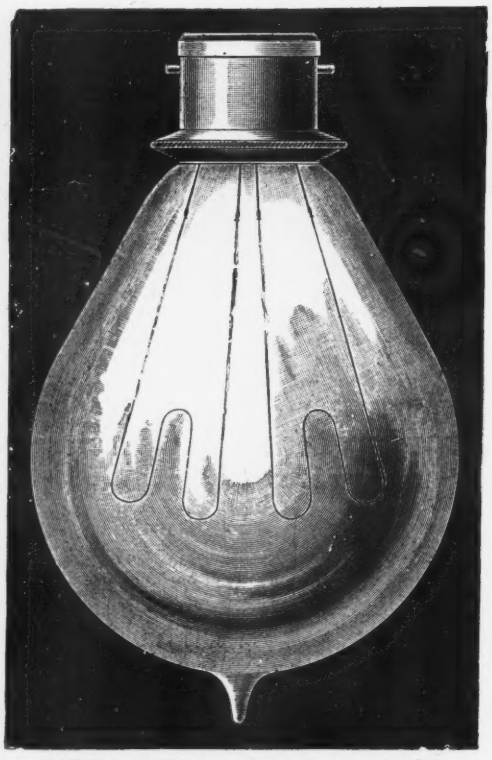

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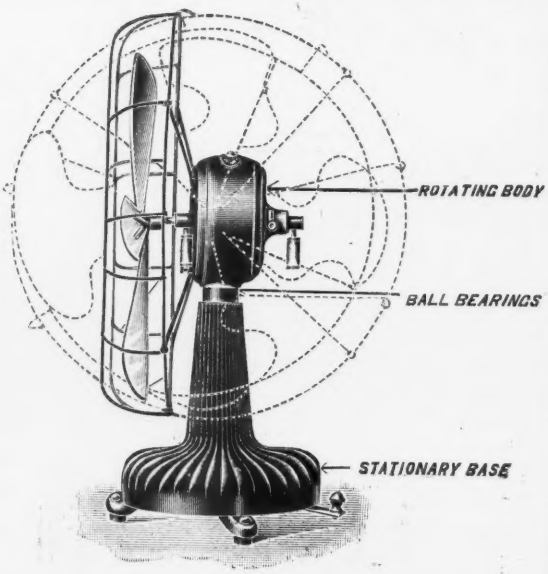

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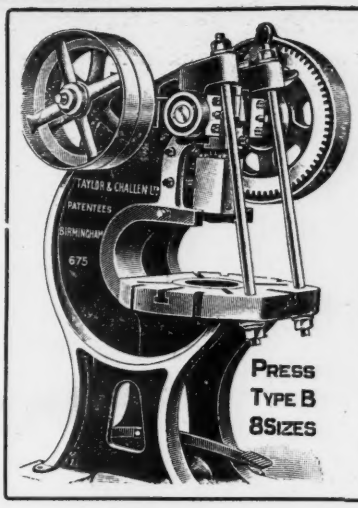

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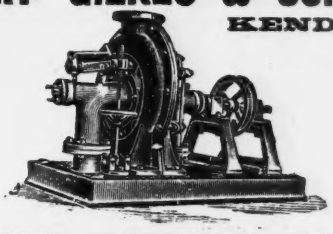

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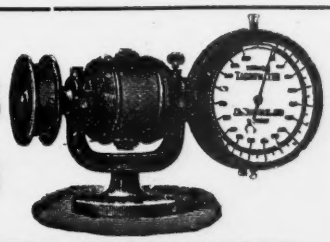

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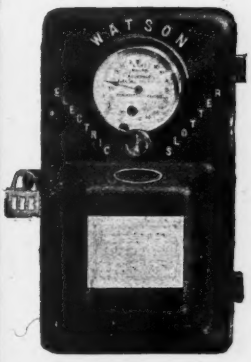

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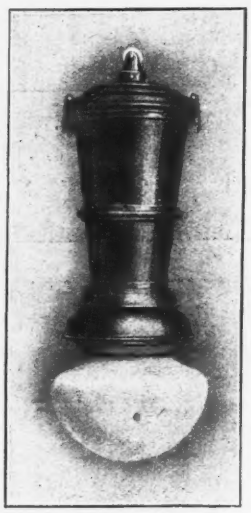

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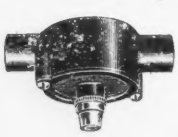

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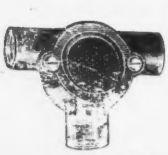

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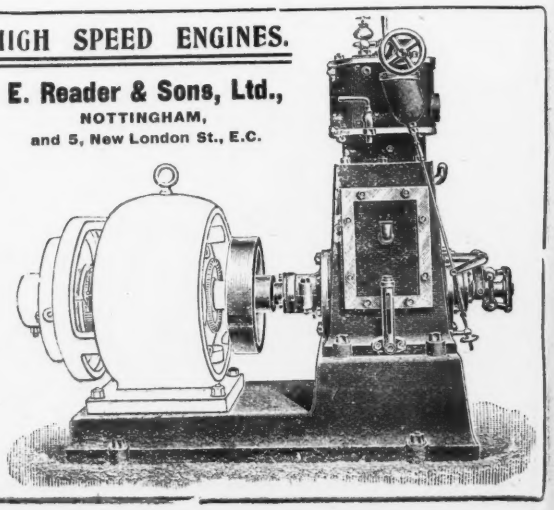

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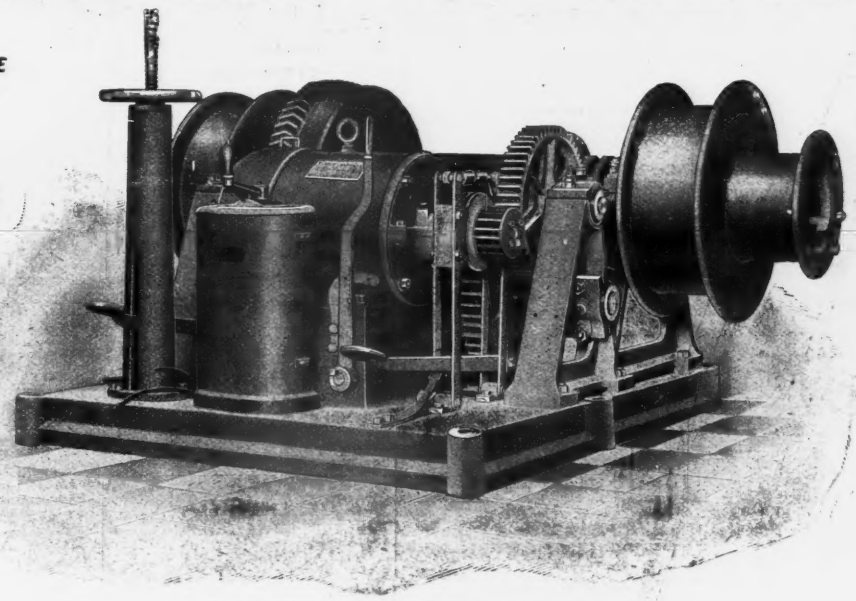

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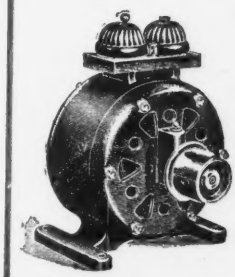

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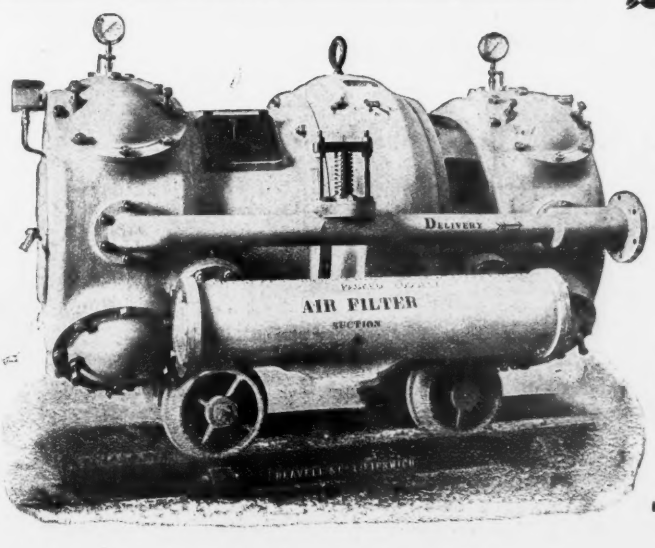

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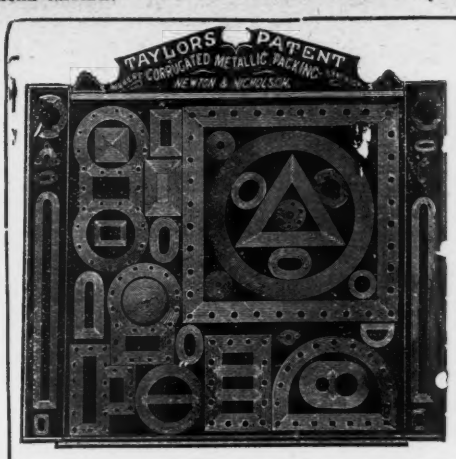

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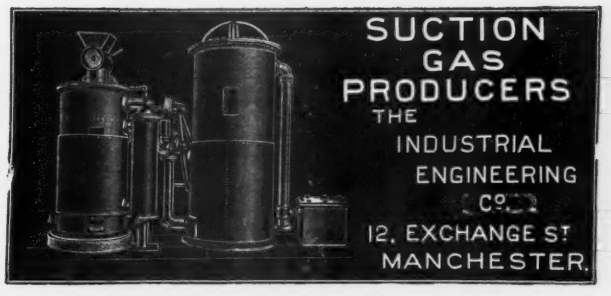

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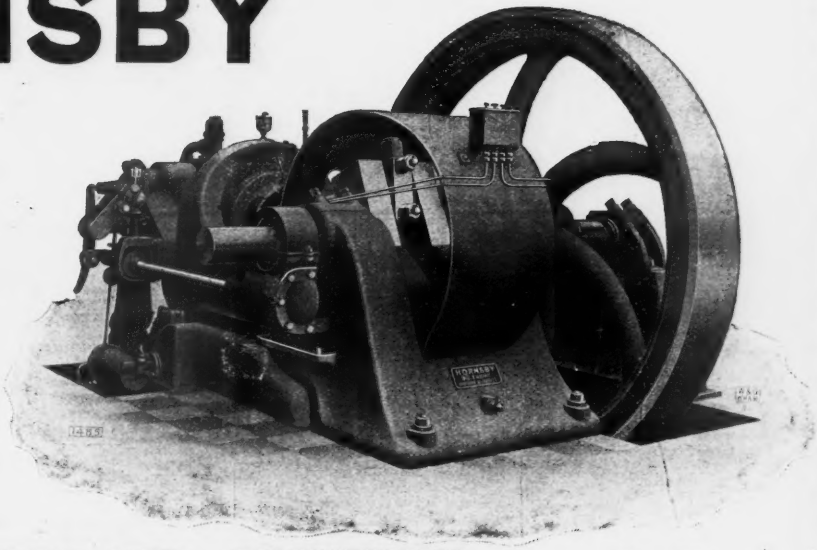

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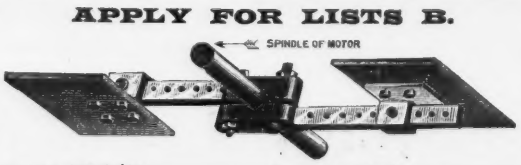

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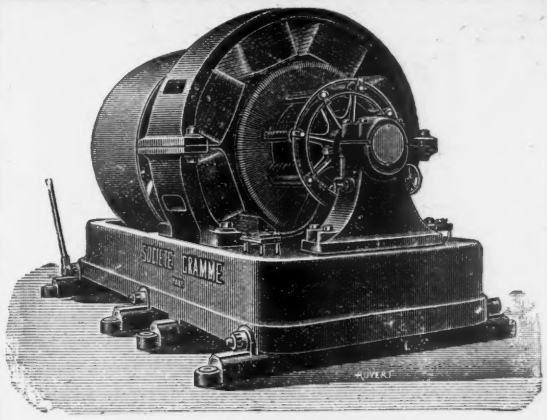

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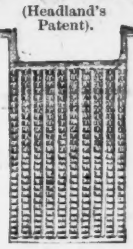

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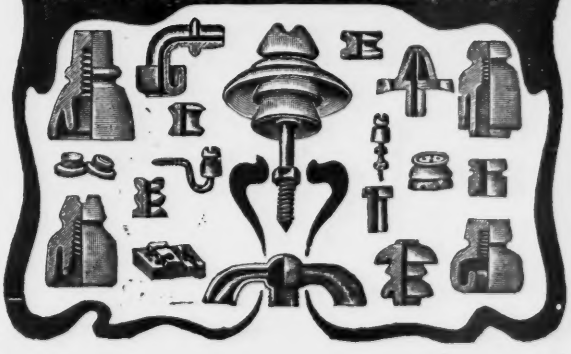

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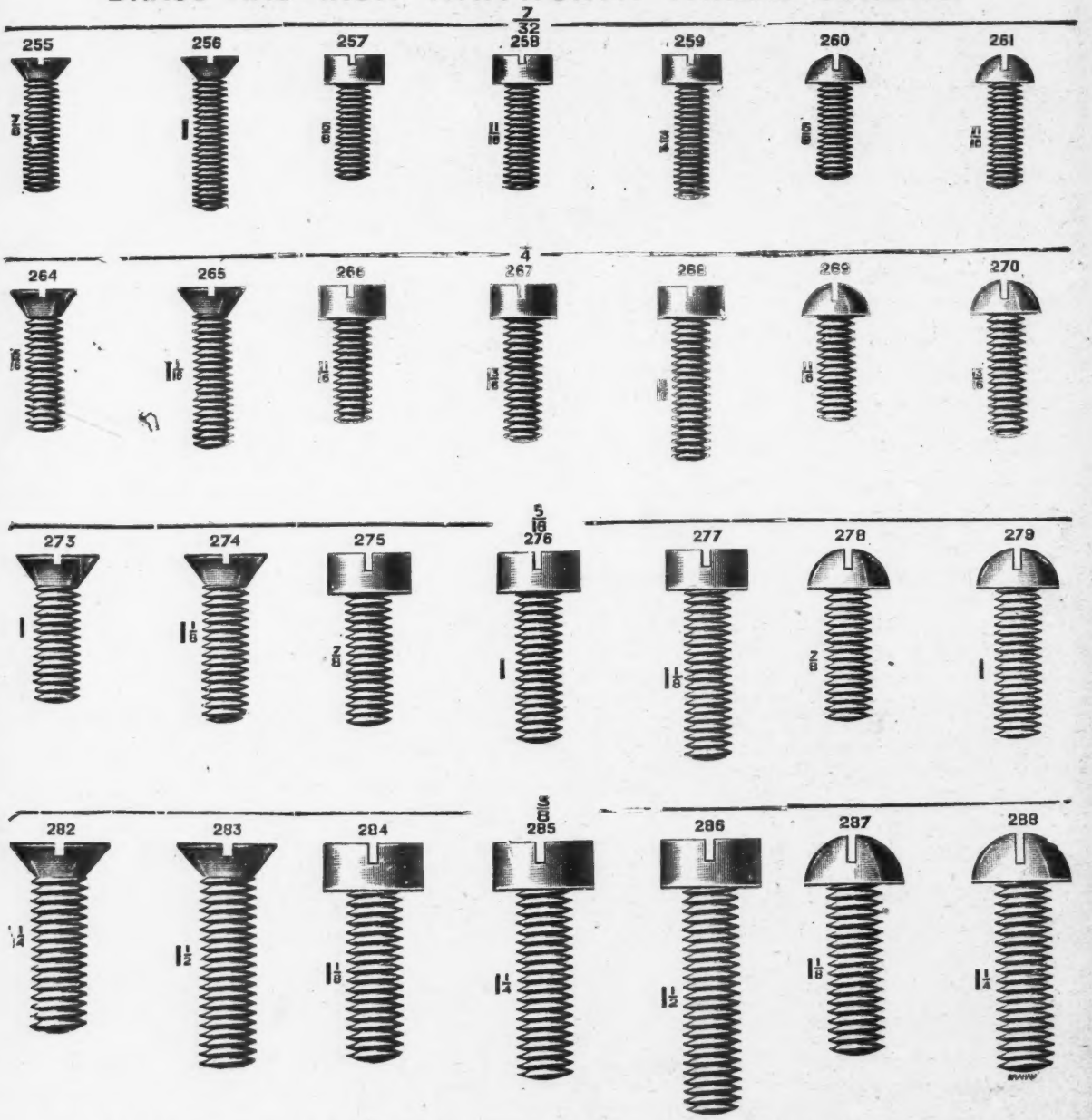

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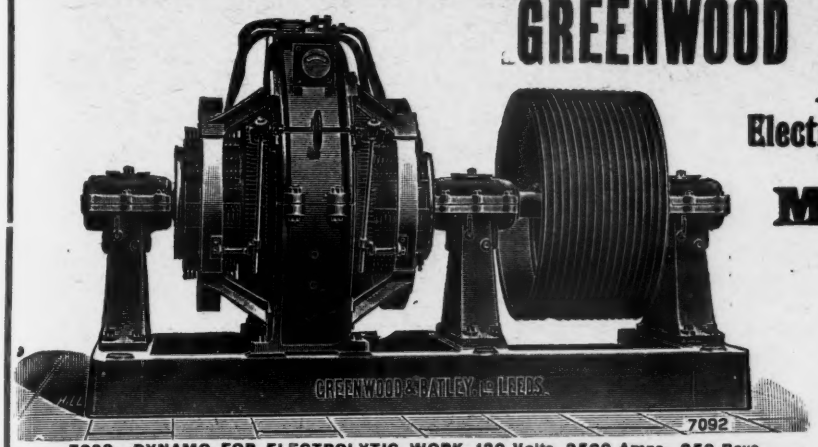

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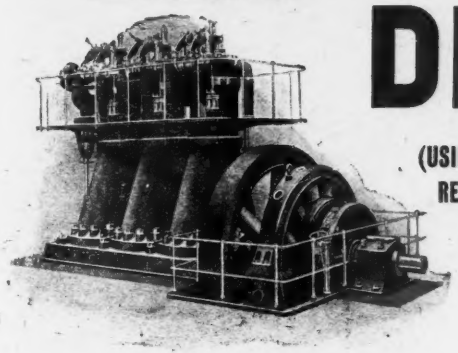
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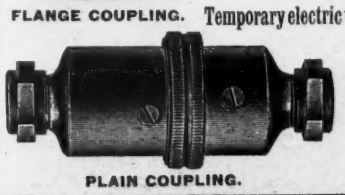
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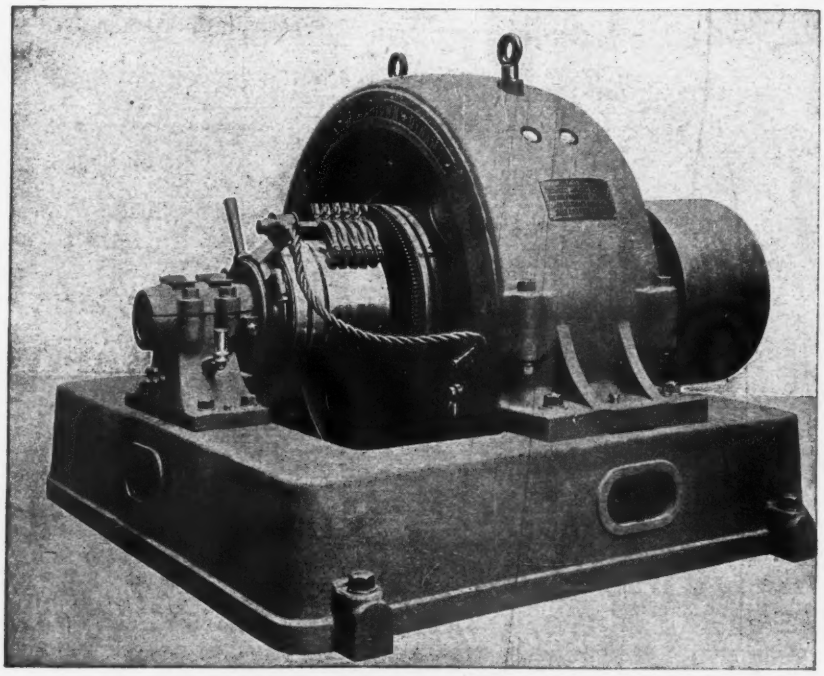

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